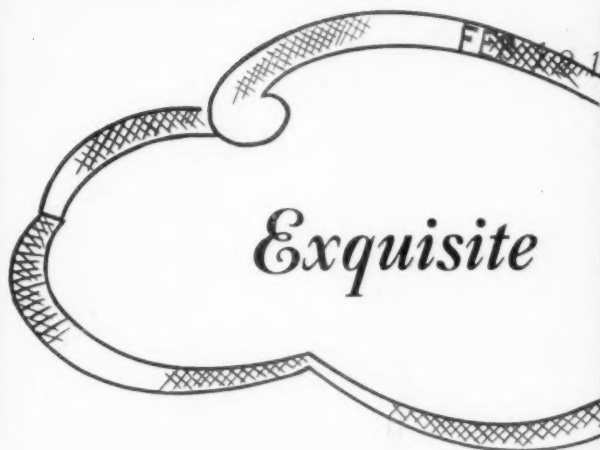


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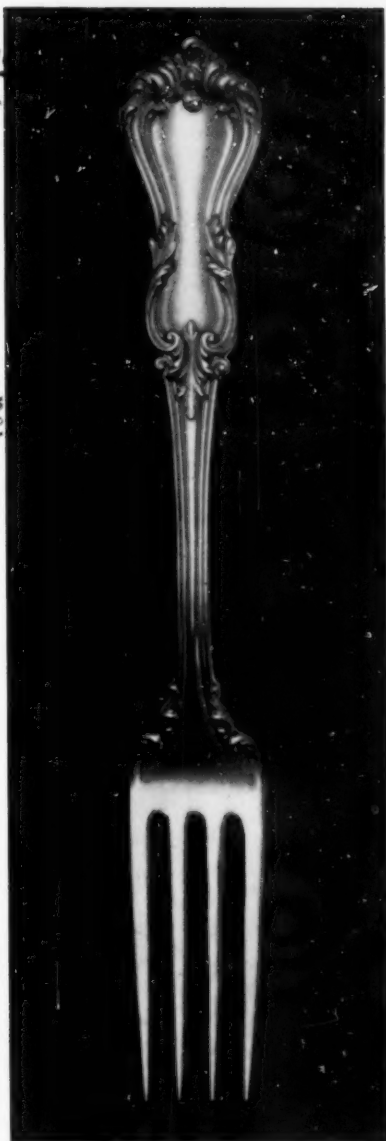
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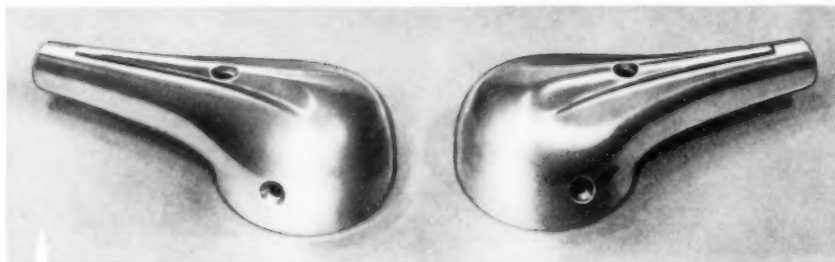
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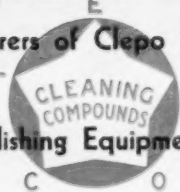
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Electrolytic Polishing of Metals

There has been great interest in the last few years in electrolytic polishing of metals, and the method is firmly established in the commercial production of fabricated stainless steel articles. The phenomenon of electrolytic polishing has probably been observed many years ago in anode corrosion in plating solutions, and a process similar to anodic polishing has been used for many years in finishing of jewelry.

It is unfortunate that the term "electrolytic polishing" was first applied to the method of brightening and removing fine surface scratches by anodic dissolution of the metal in certain electrolytes. "Electro-smoothing" or "electro-brightening" would probably be more appropriate terms for the process. Scratches with depths of the order of magnitude of 0.00005" or less are removed, but scratches having greater depth than this figure are merely brightened and are not removed. This is, no doubt, intimately associated with the exact mechanics of the process which enable brightening or preferential anodic solution to occur. The limitations to the degree of polishing, therefore, must be recognized. However, the process of electropolishing is found to be preferable to mechanical polishing in certain cases. For example, the finishing of stainless steel wire objects, such as baskets or cages, is almost impossible by mechanical means and electropolishing is particularly advantageous for this type of object. The "throwing power" or distribution of effect is rather good with most processes, and hence objects with cavities or depressions which are difficult to polish mechanically, may be brightened or smoothed electrolytically.

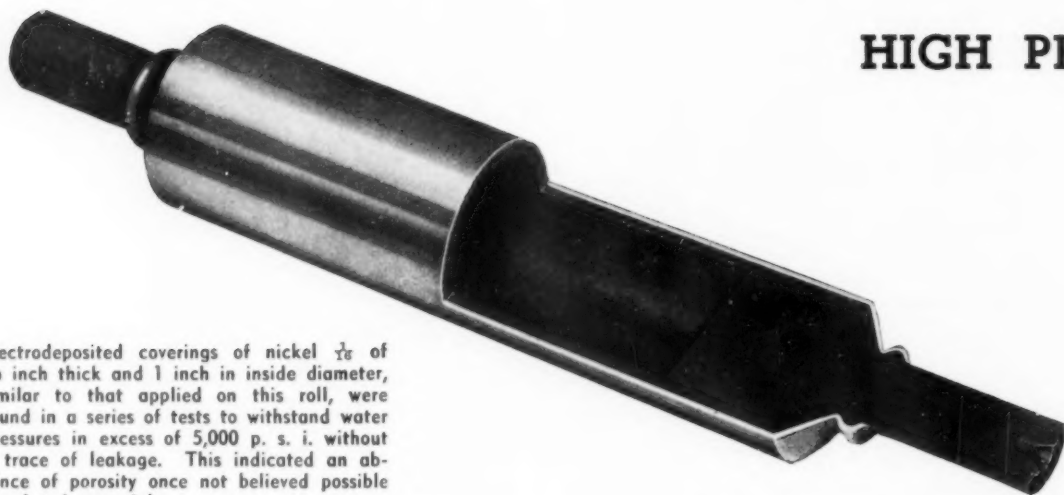
It has been found that the light reflectivity of electropolished metal surfaces is as good as or better than mechanically polished surfaces. Because of the removal of minute scratches which would tend

to hold dirt, bacteria, food, etc., electropolishing has been found to be particularly desirable for finishing of metal ware used either in the food industry or for objects which must be sterilized.

Electropolishing is done by making the work the anode in a suitable electrolyte using relatively high current densities which range from 75 to 300 amperes per sq. ft. Some of the electrolytes found suitable for the process are citric-sulfuric acid mixtures, phosphoric acid-glycerin mixtures, phosphoric-sulfuric acid mixtures and perchloric acid with acetic anhydride. It appears that the choice of electrolyte depends upon the products of the anodic dissolution being soluble to a limited extent with probably certain viscous characteristics to their water solution. One theory for electropolishing postulates that the products formed by anodic dissolution and reactance with the electrolyte form a viscous film which is thicker in the depressions than in the higher points on the surface of the metal, thus enabling a greater rate of dissolution of the higher points than the lower points on the metal surface. It has also been pointed out by Kasper that electropolishing can be explained on a theoretical electrical basis. A study of the distribution of potential around the high spots in metal as compared to that around the low spots has shown that in the vicinity of the sections of the objects with great curvature, potential gradients assume very high values even though the total potential between the electrodes may be finite and comparatively small. With such a condition, it is entirely possible for a sufficient potential gradient to build up so as to break down the film at the high spots and thus cause a preferential solution of those metal areas. Practice has shown that there is a definite relationship between the electrolyte, current density and temperature of operation.

ELECTROFORMED TUBE WITHSTANDS

HIGH PRESSURES*



Electrodeposited coverings of nickel $\frac{1}{16}$ of an inch thick and 1 inch in inside diameter, similar to that applied on this roll, were found in a series of tests to withstand water pressures in excess of 5,000 p. s. i. without a trace of leakage. This indicated an absence of porosity once not believed possible in plated material.

FURTHER evidence of the progress in modern plating methods is provided by a series of tests recently conducted on electroformed nickel tubing $\frac{1}{16}$ of an inch thick and having a 1 inch inside diameter which was subjected to water pressures well in excess of 5,000 pounds per square inch. No trace of leakage was found, thus revealing an absence of porosity once believed impossible in plated coverings.

The tubes used for the purpose of the tests were not intended for service as a single metal. They were designed primarily to prove the value of electrodeposited layers of nickel for covering rolls of steel, aluminum, and other metals.

Bi-metal rolls of this type have been found to be of high value in the production of transparent synthetic wrappings generally identified by "cellophane" and other trade-marked names of the various manufacturers. Such rolls must be given a mirror-like finish to eliminate the danger of spotting or interference with the clarity and transparency of the finished product. They must also be protected against the corrosive effect of the wet material with which they come into contact during processing. Introduction of rust or other products of corrosion, of course, would ruin the product.

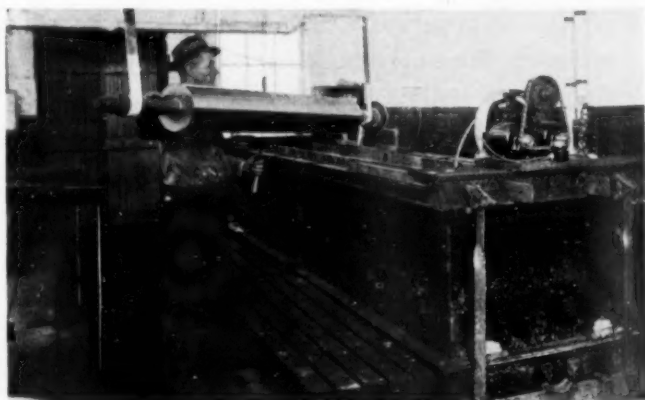
Deposited nickel not only has the required resistance to corrosion but also can be given a high finish. In addition, it offers a high degree of versatility since close technical control makes it possible to apply it in a varying range of hardnesses.

In making the tests, the same practice as used in the making of the covered roll was followed. The plating solution was regulated to provide a material with a minimum hardness of approximately 135 Brinell. In one group of tests, the nickel was applied in a thickness of $\frac{1}{16}$ of an inch to aluminum tubes. The aluminum later was dissolved chemically, leaving only the electroformed nickel tube. Water pressure was applied with increasing pressure until fracture occurred. This was at a point well above 5,000 p.s.i. No leakage was observed before fracture.

This test was a typical example from a series involving

different thicknesses on both steel and aluminum bases. While the tests were not designed for accurate calculations of physical properties and bursting pressures, it was obvious that recently published tensile properties of laboratory samples were at least equaled by these deposits from commercial baths. Laboratory tests by Dr. W. A. Wesley of The International Nickel Company had given tensile strengths from 51,000 to 132,000 p.s.i., with elongations of 28% to 1% from baths giving deposits with a hardness range from 150-360 Vickers respectively (130-340 Brinell.) None of the rather heavy deposits tested showed any evidence of porosity.

The tests were conducted at the plant of Thomas-Thiel, Inc., Wilmington, Del., which specializes in the application of plated surfaces to various materials. It was also found at the plant that thicknesses considerably greater than $\frac{1}{16}$ of an inch could be applied with the same uniformity of results.



Removing a nickel-plated roll from the plating bath. Rolls of this type whose electrodeposited nickel coverings have a minimum hardness of approximately 135 Brinell, are used to protect the clarity and transparency of transparent synthetic wrapping materials such as "cellophane" and other trade-marked products.

*Reprinted from INCO, 17, No. 3 (1940)

Rectifiers Allow Power Flexibility

BY LOUIS W. REINKEN

Engineer,
W. Green Electric Co., New York.



Louis W. Reinken

Introduction

ELECTROPLATING, which is now in the provinces of the chemist and the metallurgist, was once considered to be one of the divisions of electrical science. In fact, electroplating is one of the oldest commercial applications of electricity. Cruikshank demonstrated copper plating on an experimental scale in the early 1800's. The motor generator was invented in 1831 by Faraday—the great-grandfather of all electrical engineers. As early as 1838 Canning (founder of the great British firm of the same name) was building "dynamos" for electroplating. This was only two years after the first practical telegraph systems, and nearly 40 years before the telephone and practical electric lighting, and more than 40 years before the general use of the electric motor.

Considering the tremendous changes in these other children of electricity, it seems extraordinary that *electrical* progress in the science of electroplating has been so slight. It is true that the original Canning dynamo would look pretty crude compared to our present machines, but fundamentally they are much the same. More important—the circuits are almost identical. Although an electroplater of a century ago would be completely baffled by our chemical formulas, he would feel quite at home with our electrical circuit diagrams.

The introduction of the rectifier as a power supply unit for electroplating has changed this situation. A single large rectifier *can* simply be substituted in a standard motor-

The rectifier as a source of power for plating allows considerable electrical flexibility. Some of the possible combinations with rectifier units are outlined.—Ed.

generator plating circuit and will give perfect satisfaction. However, electroplaters are discovering that rectifiers, properly selected and used, provide a degree of flexibility not previously possible in plating plants. It is the purpose of this article to outline some of the ideas already put into practice.

Flexibility of Arrangement

Rectifiers of similar types always deliver electrical currents of exactly the same type. Rectifiers can, therefore, be connected in series or parallel just like batteries. For example, Fig. 1 represents a rectifier which can deliver (maximum) 100 amperes at 6 volts. Fig. 2a shows two such

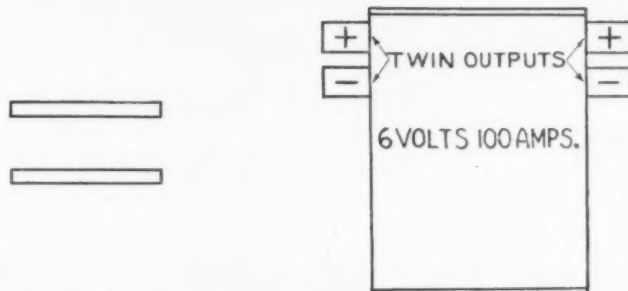
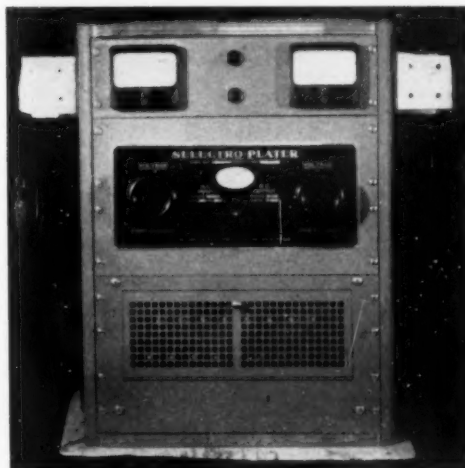


Fig. 1. Photograph and diagram of 100 ampere, 6 volt rectifier.

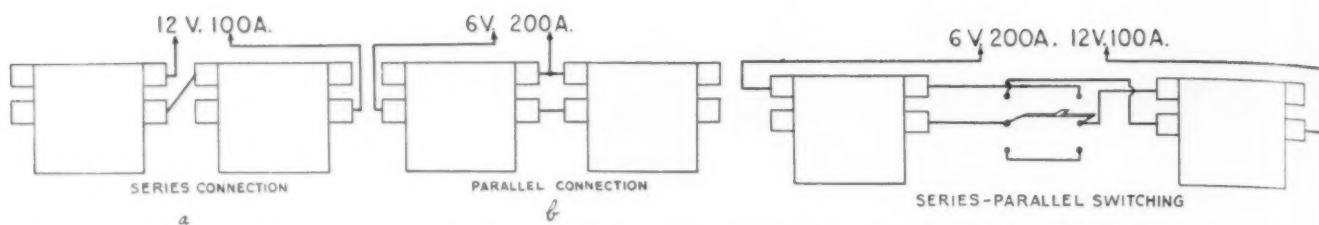


Fig. 2. Diagrams of various connections possible for two rectifiers each of 100 ampere, 6 volt rating. The series connection shown in *a* will give 100 amperes, 12 volts. The parallel connection shown in *b* will give 200 amperes at 6 volts. The series parallel arrangement of *c* will give either *a* or *b* power output.

rectifiers connected in *series*. The two together will deliver 100 amperes at 12 volts—twice the voltage of one rectifier.

Fig. 2*b* shows the same two rectifiers connected in a different way—in *parallel*. The output capacity is now 200 amperes at 6 volts—twice the current available from one rectifier.

Obviously it is possible to use a switch to provide a choice of either connection 2*a* or 2*b*. Fig. 2*c* shows this arrangement using a "series—parallel switch." This combination provides a choice of 100 ampere capacity at 12 volts, or 200 amperes at 6 volts. This arrangement is very useful in plants which use low voltage processes for the bulk of their work, and high voltage processes for part of the time. Of course, if both low and high voltage processes are in constant use, it would be necessary to have separate rectifier combinations—one low voltage and one high.

Even then it would be wise to make up the high voltage rectifier of two or more low voltage units connected in

series, since the individual units can then always be used together (in *parallel*) or separately on low voltage processes also.

Any number of similar rectifiers can be operated in *series* or in *parallel* to obtain any desired voltage or current. It is desirable, however, to standardize, if possible, on one type and size of individual unit because this provides the maximum possible flexibility. As an example of the electrical flexibility which can thus be obtained, here is a list of the combinations available with four rectifier units, each capable of delivering 100 amperes at 6 volts. (Refer to Fig. 3 for the corresponding circuit sketches.)

- Four separate units feeding separate tanks or groups of tanks, each 100 amperes at 6 volts.
- Two separate combinations, each 200 amperes at 6 volts.
- Two separate combinations, one 300 amperes at 6 volts, one 100 amperes at 6 volts.

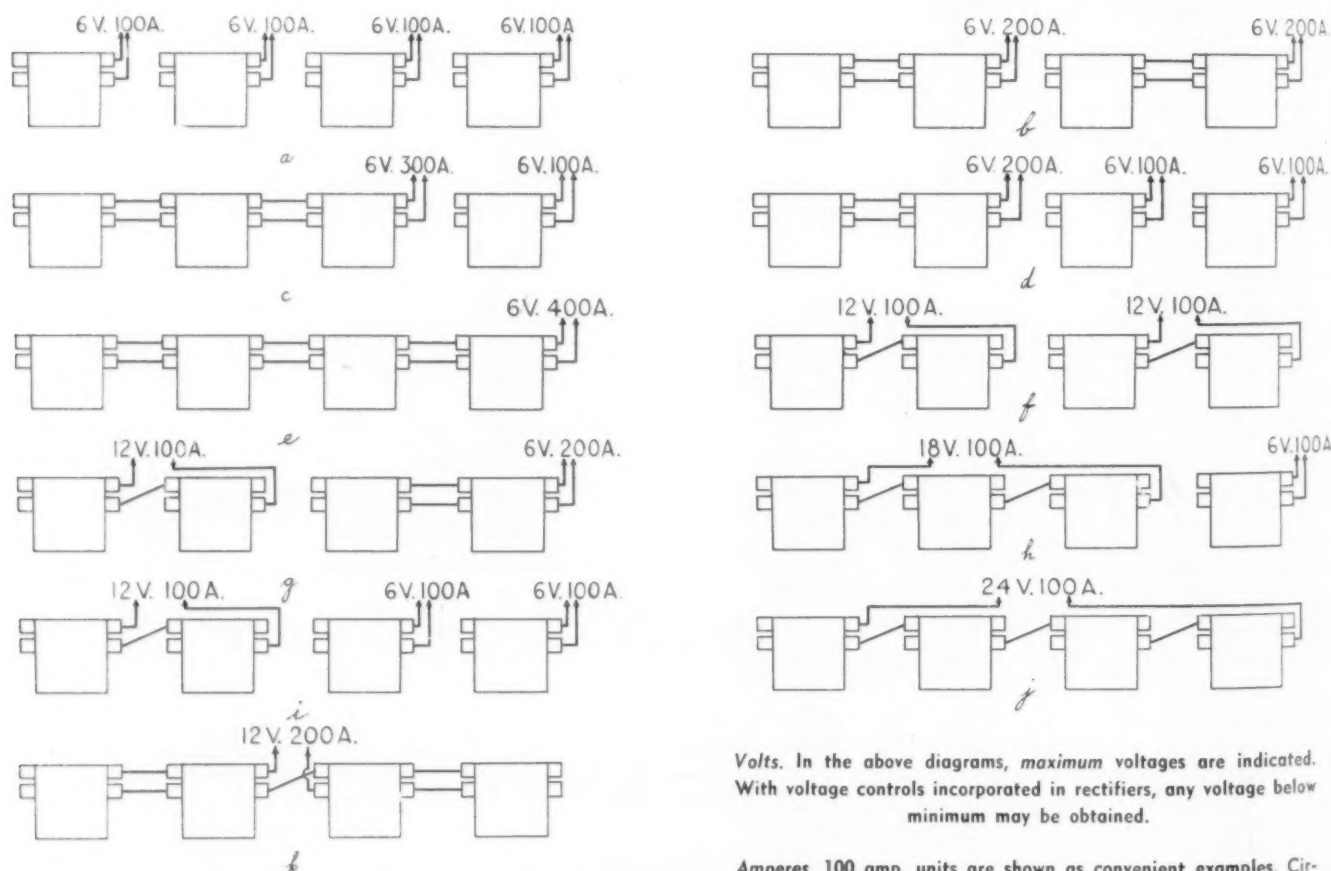


Fig. 3. Possible combinations of power output for four rectifiers of 100 ampere, 6 volt rating.

Volts. In the above diagrams, *maximum* voltages are indicated. With voltage controls incorporated in rectifiers, any voltage below minimum may be obtained.

Amperes. 100 amp. units are shown as convenient examples. Circuits are equally applicable to any size from 10 to 10,000 amps.

- (d) Three separate combinations, one 200 amperes at 6 volts, two each 100 amperes at 6 volts.
- (e) One combination, 400 amperes at 6 volts.
- (f) Two separate combinations, each 100 amperes at 12 volts.
- (g) Two separate combinations, one 100 amperes at 12 volts, one 200 amperes at 6 volts.
- (h) Two separate combinations, one 100 amperes at 18 volts, one 100 amperes at 6 volts.
- (i) Three separate combinations, one 100 amperes at 12 volts, one each 100 amperes at 6 volts.
- (j) One combination, 100 amperes at 24 volts.
- (k) One combination, 200 amperes at 12 volts.

It will be noted that mention is made of using as many as four separate rectifier units. Actually a considerably larger number may be used without hesitation since modern rectifiers are available in which maintenance is practically zero and life is unlimited. In fact, there are very sound dollars-and-cents reasons why several separate rectifiers are preferable to one.

Resistance Control Is Power Waste

In order to appreciate this, it is necessary to review some elementary electrical engineering facts. The most important of these is this—reduction in voltage by means of resistances or rheostats is achieved by converting the “excess” voltage into heat. This heat, quite apart from its undesirable effect on the already overcrowded atmosphere of the average plating plant, represents wasted power—which must be paid for just as is the power consumed in the tank in doing useful work.

This power wastage can be quite considerable. For example, if the bus voltage is 6 volts and the required tank voltage is 3 volts, then exactly half the power must be dissipated in the form of heat. In other words, no matter what the efficiency of the power supply unit feeding the bus, the overall efficiency cannot be more than half of the power supply efficiency.

Obviously, if a single power supply unit is used to feed all the tanks in the shop, then the bus voltage must be at least high enough to suit that tank (usually electrocleaning) which needs the highest voltage, and lower voltage tanks must be fed through “voltage dropping” rheostats.

It is a relatively simple matter to construct a rectifier incorporating a voltage controlling device which permits the voltage to be accurately set to any desirable value from a fraction of a volt up to maximum. Furthermore, this control can be inserted at a point in the circuit of the rectifier equipment where the power has not yet been converted from AC to DC and it is, therefore, not necessary to use a rheostat. This avoids resistive power loss and maintains the overall efficiency at comparatively high voltage at any voltage.

William Stuart many years ago lived at 25 City Hall Place. He was a photo-engraver and succeeded in putting the entire Lord's Prayer on the head of a pin, together with his name and the year, making 267 letters in all. The pin looked at with the naked eye seemed to have a slightly roughened head but when read under a strong magnifying glass, the letters were perfectly legible.

The blacksmith of old worked in bronze, gold, silver and brass. The legend is that because he made tools for the other workers of the temple of Solomon, the King honored the blacksmith above all other workers.

In the Lake Superior region in northern Michigan are wonderful copper mines. The shafts go down to a depth of over a mile.

The gold held by the United States weighs over 13,000 tons.

Michael Angelo, one of the most distinguished sculptors of the modern world as well as one of the greatest painters was apprenticed at the age of 13 to a goldsmith, Ghirlandajo by name. He served 3 years, a period which is said to have contributed a great deal to his mastery of the use of tools and treatment of metals.

Advantages of Rectifier Unit Use

The foregoing considerations indicate the desirability of using a *separate rectifier for each tank* or group of tanks operating at the same voltage. This scheme immediately produces a considerable number of interrelated advantages:

- (1) Long bus bar runs and loss of power in bus bars are eliminated.
- (2) Tank rheostats and their considerable power wastage are also eliminated.
- (3) Each tank, or group of tanks, is independent of the others, and no change of voltage is produced by moving work into or out of other tanks. This cuts down the need for constant supervision and produces more uniform and easily controlled results.
- (4) Only those tanks which are actually in use draw power. Other tank rectifiers can be shut down. No need to “use a ten-ton truck to do a station-wagon job.”
- (5) Referring to the earlier paragraphs on combinations, it is obvious that individual tank units can always be utilized in the future, either in parallel to handle a heavy current load, or in series to provide higher voltages for special processes.

Mechanical Flexibility

The last item in the above list introduces another aspect of flexibility—namely, *mechanical flexibility*. The ideal electroplating power supply unit would be completely mobile. The ideal can be rather closely approached with a unit type rectifier on wheels.

A rectifier equipment of this type† delivering 1500 amperes at 6 volts can be housed in a single cabinet including also all controls and meters, which requires less than 3 sq. ft. of floor space and weighs less than 1000 pounds. A unit of this type, on caster wheels, can easily be shifted from point to point in the plating plant. Smaller rectifiers, for example, 25 or 50 ampere units for barrels or small tanks, are not much bigger than a table-model radio and can be installed just as easily.

The writer would like to conclude by acknowledging that the ideas outlined in these notes are not entirely original. Thanks are due to former colleagues abroad and in this country, also to the many electroplaters who had the initiative to depart from traditional practice and the ingenuity to develop these ideas in practice. It is the writer's hope that this brief report will assist other workers in this country in the development of more flexibility and economy in plating plant operation.

†Selenium type

Treatment of Plating Room Waste Water

BY MILTON E. HODGES

*Asst. Plant Engineer,
Electrolux Corp., Old Greenwich, Conn.*



Milton E. Hodges

THERE are many problems to be considered in connection with the treatment of plating room waste water, as well as other types of industrial waste. As the trend by local, state and federal authorities increases towards the purification of polluted streams and coastal waters, this problem will affect more and more industries.

Very little information has been published which covers the treatment and disposal of plating room waste water. Of the limited number of articles on this subject, an interesting one was recently written by T. J. Fadgen,* Process Engineer of the General Motors Corporation, in which he discussed the trade waste of the Trenton Division of the Ternstedt Manufacturing Corp. Mr. Fadgen's article covers the plating room waste, as well as trade waste from all areas of the plant, including waters from factory air purifying systems, cooling units on die casting machines, and condensing coils on degreasers, and deals mainly with the separation of oil, screening of lint and solid matter, the disposal of cyanide, and the neutralizing of acid wastes.

The preliminary research on the subject of our plating room waste water has been conducted under the direction of Professor C. R. Hoover, of Wesleyan University. The

Electrolux Corporation at Old Greenwich, Connecticut, has cooperated with W. R. Copeland, Chief Engineer of the State Water Commission, and with Professor Hoover, in the construction and operation of a plant to treat the plating room waste water. By means of this treatment, waste water may be emptied into either the sanitary sewer, where it is subjected to sewage plant treatment, or directly into a nearby creek. It may be added here that the creek flows into Long Island Sound, in the vicinity of many bathing beaches. It is, therefore, quite essential that the color of the waste water also be removed. The principal requirement of the sewage department is that the pH of the waste water be 7 or above, in order that it will not interfere with the operation of the sewage disposal plant.

Purification Plant

The purification plant (Fig. 1) was constructed at one corner of the factory property. The plant consists of a small building which houses the necessary pumping equipment, mixing tanks, filter press, and a laboratory for the analysis of the waste water. The pumping equipment consists of two 150 G.P.M. centrifugal pumps, controlled by an automatic float switch and mounted over a 3,000-gallon concrete retention pit. These pumps are used to deliver the waste water to treatment tanks. Two cypress mixing tanks were installed, one of 400-gallon capacity equipped with an electric portable agitator, and one of 100-gallon capacity. These tanks are used for mixing the necessary chemicals and are connected to a 20 G.P.M. centrifugal pump, in order that

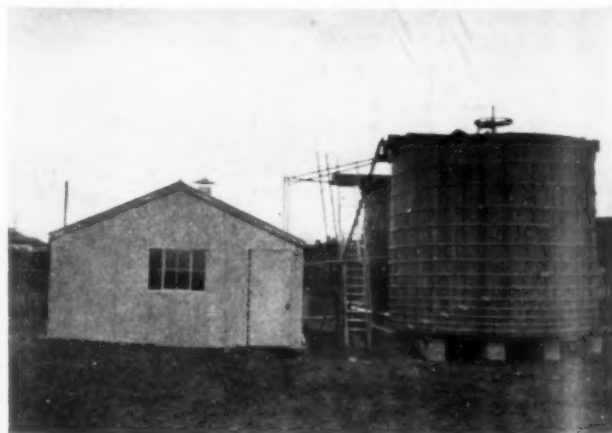


Fig. 1. View of the purification plant.

*Proceedings, Twenty-eighth Annual Convention, A.E.S., p. 44, (1940).

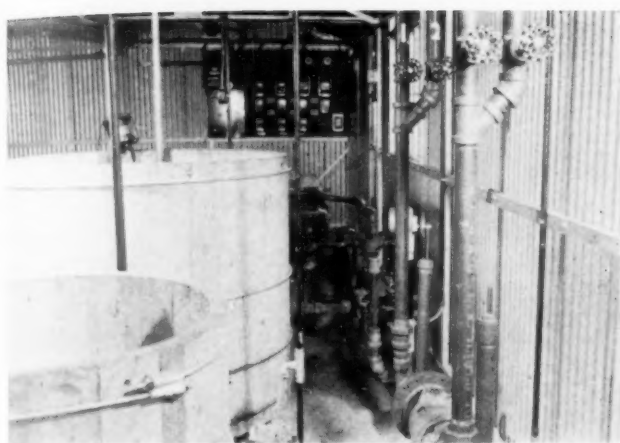


Fig. 2. Treatment tanks.

solutions from either tank may be pumped into the treatment tanks (Fig. 2). An exhaust blower is provided over these two mixing tanks to exhaust any fumes that may be emitted from the chemicals being mixed. A diaphragm pump of 4 G.P.M. capacity and a 5.2 cubic feet capacity filter press were installed to handle the precipitate from the treatment tanks (Fig. 3).

Two cypress treatment tanks were erected for the purpose of treating our waste water. These tanks are of 20,800 gallon capacity, and each is equipped with a mechanical agitator which rotates at a speed of approximately 3 R.P.M. These agitators are operated by a 5 H.P. motor mounted between the two tanks in such a manner that either or both agitators may be operated simultaneously or separately (Figures 4 and 5). These tanks are also equipped with drain pipes which will be described later.

The plating room waste water is piped directly from the plating room to the storage pit. This waste water comes from the rinse tanks in the plating room, where are nickel sulphate, copper cyanide, cadmium cyanide, and chromic acid plating tanks, along with the usual amount of cleaning and pickling tanks and their rinses. Most of the color in this waste water comes from the chromic acid rinse and we have found that the waste varies between 100 and 400 parts per million of chromium. Chromic acid, of course, is very

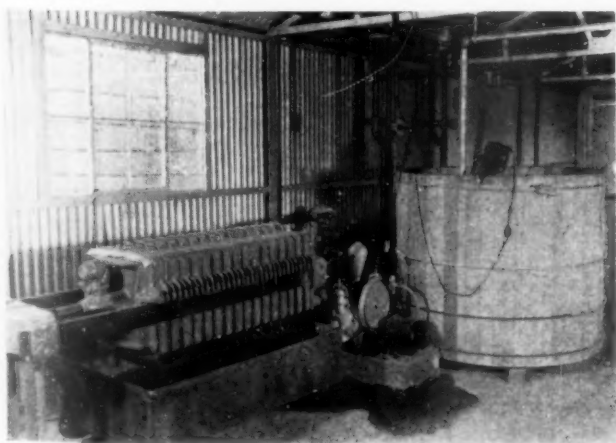


Fig. 3. Pump and filter press to handle the precipitate from treatment tanks.



Fig. 4. Outside view of cypress treatment tanks.

soluble, and only a small amount is required to produce considerable discoloration.

Processing

The waste water is drained from the plating room to the storage pit and is pumped into one of the treatment tanks. When this tank becomes full, or contains a day's run, the solution is agitated a few minutes, after which a sample is dipped out and taken to the laboratory for analysis.

Up to the present time, we have come to the conclusion that the most feasible method of treatment is to add barium sulphide and hydrated lime to the waste water. This treatment reduces the hexavalent chromium to trivalent chromium, and the copper and nickel form hydroxides or sulphides. These metals largely precipitate out when the pH of the solution is raised to about 6 or above. The precipitate forms a slurry, which settles to the bottom of the tank, from whence it is pumped into the filter press and may be drained off. Although the equipment is entirely adequate for the process, it has been so designed that it will be practical for use in investigating other means of treatment.

A three-inch drain pipe has been constructed in each of the treatment tanks, in such a manner that it can be lowered
(Concluded on page 83)



Fig. 5. Agitator for two waste treatment tanks. The agitator is mounted between the two tanks.

Automatic Equipment for Plating

By Robert W. Shaffer

*Supervisor of Plating,
Snap-On Tools Corp., Kenosha, Wis.*

ONE can't help but notice that today the good appearance of an article, which includes its finish, determines its salability. It therefore seems logical that the finish of a product is one of the important steps in its manufacture. With so much thought being given to ways and means of installing mechanical handling methods for the fabrication and assembling of a given product, the need for efficient continuous economical procedure in finishing operations should not be overlooked. It is the height of folly to have production move with clock-like regularity and precision along a production line, only to reach a jam in the plating or finishing section with work piled up because antiquated methods are being used. Happily, however, many industrialists have taken steps to correct traffic jams in the finishing room by installing automatic dipping equipment,—either for pretreatment in connection with organic finishing; or, where plating is a part of the finishing process, the equipment may combine that for pretreatment as well as that for the final plating. In some plants equipment is installed for plating only.

Automatic equipment may be divided into two general classifications: full automatic and semi-automatic. Semi-automatic machines are really not "semi-automatic" in the strict sense of the term but are only semi-automatic in the sense that they allow the timing of a deposit and reduce walking of the operator. All of the cleaning, pickling and rinsing are done separately.

Full automatic machines are of many types and may be roughly divided into the following classifications: straight-away or straight-line, and return type units. The return type units may be further classified into several types among which are: the sidearm type, the elevator type, the angle type and various types with the lifting mechanism directly over the tanks.

The Straight Line Machine

The straight-away or straight line machines, are for mass production or for handling material that is extremely bulky or too heavy for lighter units, or where current requirements per rack are extremely high, and where straight line operation fits in with general operating routine. This type has a loading station at one end and an unloading station at the opposite end, the work advancing in a straight line from one point to another.

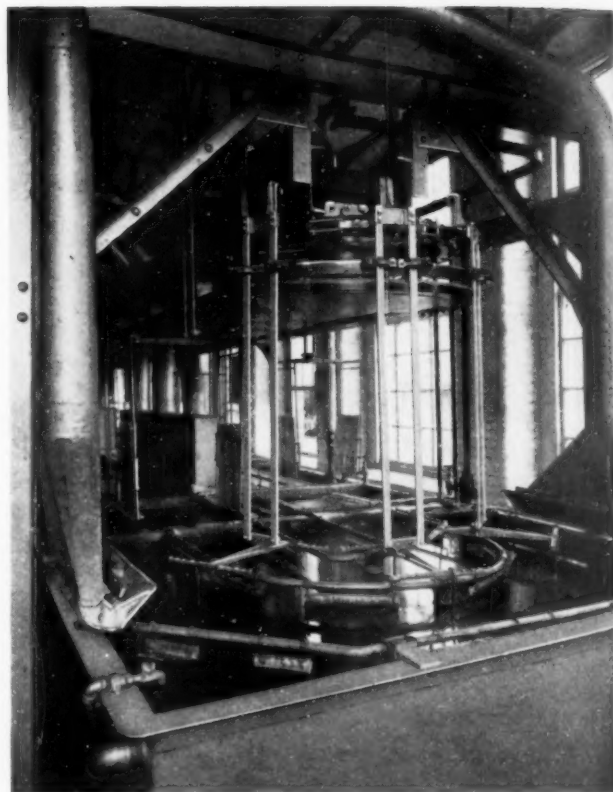


Fig. 1. Idler end of an overhead, return type conveyor.
(Courtesy Hanson-Van Winkle-Munning Co., Matawan, N. J.)

Such machines are usually specially designed and can be built to any length and for any production sequence. The work is suspended from horizontally placed carrier rods, each carrying a number of racks. The rods are moved along by two synchronized main conveying chains, one at each end of the carrier rods. As the racks approach the end of one tank, the ends of the carrier rods come in contact with an extension cup or a knob on the chain of the transfer mechanism (consisting of roller chain loops, one on each side of the machine, and operating in a vertical plane independently from the main conveying chains, but synchronized with them), which carry the work upward out of the one tank, over the sprocket to advance it toward the next tank, and immediately lower it into it for the required time, continuing to move along progressively, thus taking the work through the entire series of tanks. Upon reaching the end of the last tank, the work is removed and the rods returned to the starting point by a separate chain. Conveying and transfer chains operate continuously at a predetermined speed, and all forward moving chains are in perfect synchronization. With the transfer chains operating independently of the conveying chains, it is possible to



(Above) Enameling end of conveyor showing baking ovens at right.

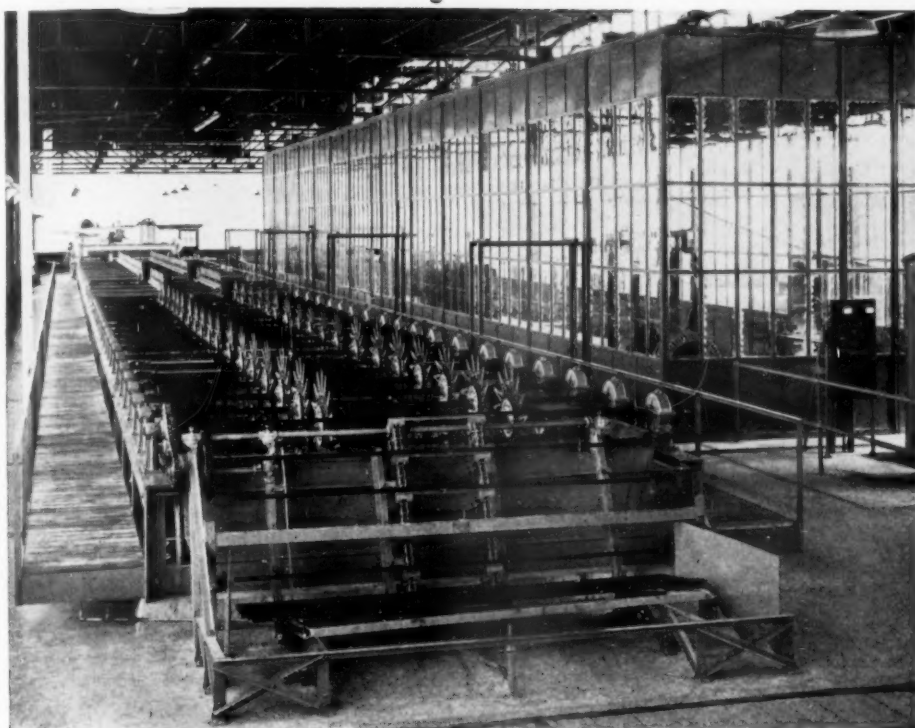


Fig. 2. Automatic straight-line type machine for galvanizing and enameling conduit. The unit is 207' long and 15' wide; is completely automatic and operates under the supervision of one man. The production is ten 10' lengths a minute, or a day's output, with a double shift, of 142,000'.

(Courtesy U. S. Galvanizing & Plating Equipment Corp., Brooklyn, N. Y.)

From the carrier at the end of this 207' unit, the sprockets or spiders, which project on top, pick up lengths of conduit pipe and carry them through the various operations. To the right is the glass enclosed generator room.

provide fast transfers and slow transfers, wide transfers and narrow transfers, and yet have them all perfectly synchronized.

RETURN TYPES

In the return types, the principle of making a circuit and returning the completed work to the starting point is adopted, both loading and unloading being done at the same place. This point may be established either at the end or along one side of the unit, to suit the convenience for handling material coming from or being dispatched to other departments.

They are more compact than the straight line, taking up less floor space.

One return type unit consists of two parallel rows of tanks beneath the conveyor mechanism operating on a supporting frame-work somewhat similar to that of the straight-a-way unit, having, however, but a single convey-

ing chain. The work carriers are vertical members moved along by pusher pins spaced at intervals on the main conveying chain. The rack on which the work is suspended is carried along until it encounters the transfer loop, which then carries the rack upward and forward and then lowers it into the next tank. In the return type machine only one chain loop is used at transfer points, the transfer loops also operating independently of the one main conveying chain, yet synchronized with it.

Elevator Type

The elevator type of full automatic dipping equipment is another that is commonly used for medium and heavy duty work. While the principle of the raising and lowering is similar to those previously described, the operation differs in that submersions are all made for the same length of time, the time of submergence being prede-

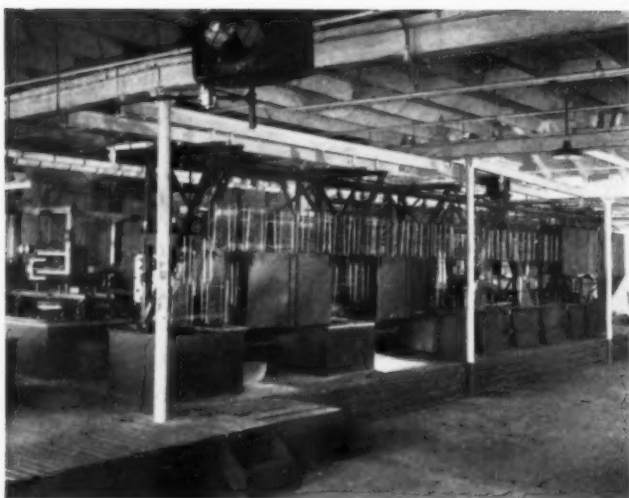


Fig. 3. View of angle type conveyor showing various set-ups of the tanks and the outline of the chain on the angle.

(Courtesy LaSalco, Inc., St. Louis, Mo.)

terminated and the mechanical operation of the complete equipment being designed accordingly. Instead of conveying equipment along over a series of tanks, the complete operating mechanism is erected in the center of a circle of tanks. Arms extend from this central mechanism on which are hung fixtures or racks carrying the parts to be treated, or baskets or barrels if a number of small parts are to be immersed. These arms or carriers are mounted on rollers operating in guide channels. Two conveyor chains, one at the top and the other at the bottom, when driven move the carriers and the guides forward to positions over the various tanks successively, thus advancing the work from one solution to the next. The elevator, mentioned above, lifts the work out of one solution and lowers it into the next when in the proper position. This elevator is counterbalanced and slides on vertical guide tubes, moving up and down within a fixed distance.

The elevator mechanism may be operated by hydraulic cylinders, using a geared motor to drive the conveyor chains which advance the carriers from

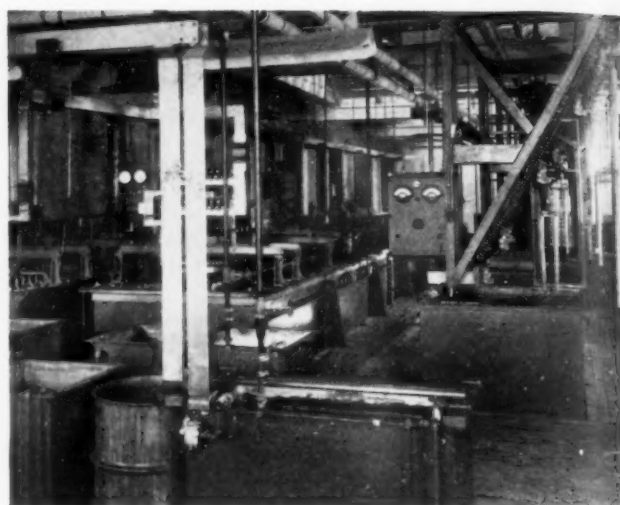


Fig. 5. Loading end of angle type conveyor. The conveyor is loaded on the downward travel of the chain.

station to station. Or, a horizontal cylinder may replace the motor drive, making the entire machine hydraulically actuated. The elevator may also be operated with a crank and connecting rod rotating through 360° in raising and lowering the elevator. Operated thus, part of the crank travel is utilized to operate a lever that moves the chain forward and advances the carriers. A third method of operating this machine is through a chain on the sprocket drive, in which case a separate drive geared to the forward drive chain moves the carriers from one station to another. No matter which type of drive is utilized, both forward and elevating drives are synchronized.

Whenever agitation is desired while the work is in the solution, it may be provided by a short up and down motion of the elevator, or the forward drive chain may be operated to move forward and backward within a short distance. The duration of the treatment may be varied to suit the kind of work to be performed with a fixed transfer time being maintained.

The Side-Arm Type

Another automatic return type plating machine is the side-arm type. These machines can be designed for either intermittent or continuous movement. In both types of machines, the operating mechanism is located between parallel rows of tanks. This arrangement lessens the danger of attack from corrosive fumes and permits easy ventilation. In addition, lubricating oils, paint and dirt that may be used in the machine cannot fall into the tanks and contaminate the solutions. The carrier arms are pivotally mounted in chain brackets from the main chain and the plating racks are suspended from the carriers. The speed of the conveyor chain controls the transfer time from one tank to another.

Continuous Movement: The transfer is made from one tank to the other by means of a hump type cam on which the hardened rollers on the carrier arm drive upwards, over and then into the succeeding tank. On account of the chain movement, the processing tanks must necessarily be somewhat longer than the tanks used for the same purpose when

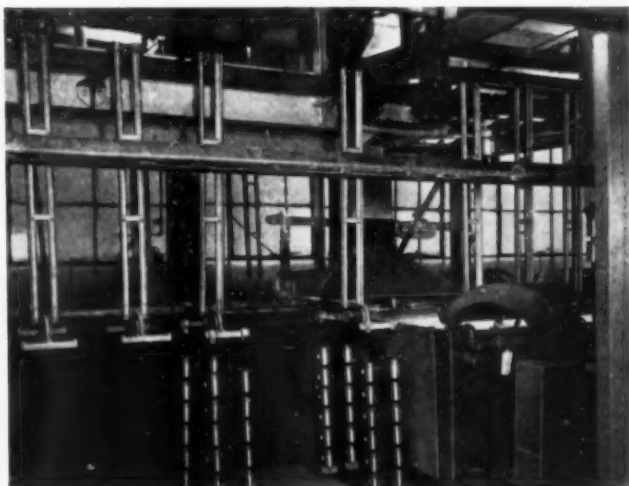


Fig. 4. Loading and unloading point of an overhead, return type automatic plating machine.

(Courtesy The Meaker Co., Chicago, Ill.)

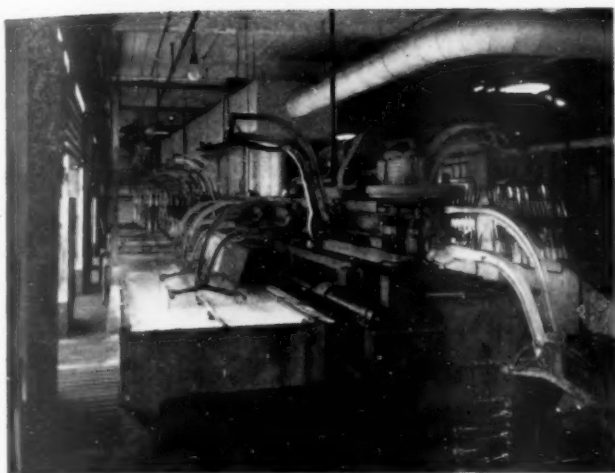


Fig. 6. Side-arm type automatic plating machine showing some side-arms in process of transfer, and others carrying work through the solutions. Loading station is at right.

(Courtesy Frederic B. Stevens, Inc., Detroit, Mich.)

the intermittent type of movement is employed. In one type of machine, the carrier arms are raised and lowered by means of a transfer lever attached to the load carrying tank. When the arm reaches its top-most position the work is carried over the tank and the next transfer lever lowers it into the succeeding tank.

Intermittent Movement: In this type of movement, the work is transferred from one tank to another by either the hump type transfer or by means of an auxiliary cam, the latter being synchronized with the single main chain movement. The work either remains stationary in the tank or is moved through the tank by successive steps which are correlated with the transfer periods characteristic of the machine. The transfer time remains constant—at a predetermined time—the only variable of time being the length of the rest period.

Because of vertical entry into and exit from the tanks, the auxiliary cam type of transfer permits minimum tank length and thus minimum over-all length of the plating machine.

Agitation of the cathode can be accomplished by employing a special mechanism activating the carrier arm. The rate of agitation can be varied.

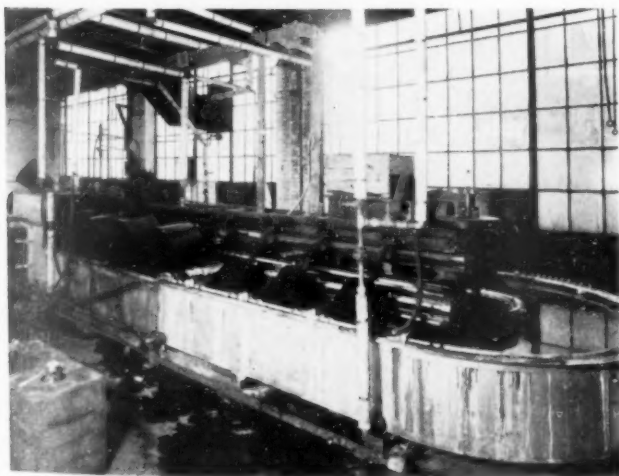


Fig. 7. Barrel type automatic machine for cleaning and plating small bulk parts.

(Courtesy Frederic B. Stevens, Inc., Detroit, Mich.)

In processes that require treating time less than the rest time, a delayed set down mechanism is provided. This mechanism allows the holding of the work above the solution for any desired length of time and thus the treating time can be varied within the rest period.

One type of side-arm machine accomplishes the transfer from tank to tank through a curved load carrying track or cam.

Stop and start mechanisms are used where the main conveyor operates at relatively slow speed, which means long exposures to the air between operation without the use of a stop and start arrangement.

In the modified side-arm machine, the rack is swung from one tank to another, from the vertical to the horizontal position instead of the usual raising and lowering. This type of machine is said to be particularly good for small and cup-shaped pieces because when the racks are raised into the horizontal position any solution remaining in the cups is drained off. This type of machine obviously does not require a high superstructure as it is not necessary to have head clearance above the tanks equal to the length of the racks plus clearance because of the sidewise transfer of the racks. The cathode may be agitated sidewise in the solution as well as the usual forward motion. End sway is practically eliminated because of the short length of the racks and thus close placing of the tanks is possible. Automatic unloading is also possible with this type of machine and switching of racks can be readily accomplished while the machine is in motion.

Angle Type

This type of machine has been designed particularly for chromium plating. The main superstructure and conveyor carrier chains are placed on a 30° angle to the vertical thus allowing the use of thick racks and close spacing. As the first rack travels up the 30° incline, it would also move outward so that the following racks would, so-to-speak, telescope underneath or in back of the first rack. If the chain were not at a 30° angle, it would be necessary to wait until the one rack had traveled its entire length plus clearance before the second rack could move into position. The use of the current collector principle enables the obtaining of high current densities.

Small Parts Machine

Another type of side-arm machine is extensively used for cleaning and electroplating small parts—bolts, nuts, and small stampings. This is of the tumbling barrel type with baskets or barrels of perforated sheet steel coated with rubber. They are carried on bronze supporting arms attached to the conveying chain and extend downward at an angle of 45° from the horizontal. Hardened steel rollers on these arms coming in contact with hump-type cams on the frame of the machine, serve to lift the baskets from one tank and to lower them into the next. Two separate drives are provided, one for the chain which moves the arms carrying the baskets through the various stages of immersion, and the other revolving the baskets. Larger pieces not suitable for the tumbling barrel methods are handled on a similarly designed rack machine, having a series of cast

(Concluded on page 83)

A Short Research on the Effect of Base Metal Polishing on the Character of Nickel Plate[†]

Three different types of steels, namely, hot rolled bumper steel; commercial cold rolled steel, and "perfect" cold rolled steel were subjected to different polishing procedures with grits varying from 90 to 220 mesh and 0.001" of nickel was applied from a modified Watts solution.

Salt spray tests were made on the various panels to evaluate their relative porosity. It was found that the polishing grit size and procedure had a marked influence on the porosity of the nickel coatings as was previously shown by Phillips some years ago. The coarser grit sizes tended to cause more porous nickel coatings and final finishing with a 220 grease wheel gave superior results. It was indicated that scratch elimination was not definitely necessary so long as a smooth effect is obtained on the scratched tops combined with some diminution of scratch depth and width.

Introduction

The effect of surface condition of the base metal on porosity of electrodeposits has been frequently mentioned. Among many authors, to select a few noteworthy examples, Hothersall and Hammond¹ discuss surface roughness as being one of five major contributing factors to porosity. Phillips² developed that a nickel plate on a rough polish is more porous than a similar plate on a smoother polish. Bower³ in a recent publication, revealed that loose grain polishing, comparable to a burnishing operation, provided a surface for a plate of superior quality to that obtained from ordinary polishing procedures.

Specific and detailed information on the effect of well-defined basic metal defects on the plate is not yet available. Thus, as a generality, non-metallic inclusions, pores, scratches and other similar imperfections in steel have been more or less vaguely defined as being harmful to the corrosion resistance of a plate subsequently applied. Sand blasted surfaces have been described¹ as being inferior to polished surfaces. On the other hand, unpolished surfaces of good cold rolled steel have been shown¹ to present an excellent base for a plate whereas polishing such a surface decreases the corrosion resistance of the plate.

It follows, therefore, that if perfect steel could be used for plating, and if articles could be fabricated with the development of no necessity for polishing, then a research such as the one here reported would be unnecessary. The plater or corrosion engineer could then devote his entire attention to means of prevention of porosity as created in the plating operations. However, neither of the above conditions are even remotely pos-



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sible of attainment. Therefore, one does need to be concerned with the steel and with the damage, or improvement, obtained through polishing. It is the author's opinion that, in a well conducted plating process, far more than half of all corrosion difficulties are a result of the condition of the base metal.

This research, unfortunately brief, is an attempt to lay the ground work of a more complete investigation of the effect of different types of polishing on steel. The results, published as obtained, are admittedly too few in number and hence might not properly be designated as conclusions. However, the trend of the corrosion results obtained were quite definite, justifying their publication and justifying further work in seeking a reason for them.

More specifically, this paper describes an attempt to determine the effect of several different kinds of rather well defined polished surfaces on corrosion resistance and other characteristics of the plate obtained. It is the author's firm conviction that such work as is here published should be amplified and further extended in some like manner to all base metal defects as mentioned above.

[†] Reprinted from Proceedings of Annual Meeting of A.E.S., 1940.

Experimental Procedure

For the purpose of the research, three different kinds of steel were used: (1), a 1085 hot rolled, heat treated spring steel; (2), a 1010 commercial grade of cold rolled steel; (3) a selected grade of 1010 cold rolled steel presenting a highly finished surface and which presumably was substantially free from surface imperfections.

Panels of a size 3" by 8" of the three different steels were polished in twelve groups, each group consisting of from three to six duplicate pieces. The individual groups differed from each other in being polished with a different kind, or sequence of kinds of polishing grain. All panels were plated alike in a modified Watts nickel bath. The average plate thickness applied was 0.001", and efforts were made in racking and anode spacing to insure substantially the same distribution and amount of plate on all pieces. Subsequent checks revealed that this had been accomplished, within expected limits. In the plating operation, to further insure uniformity, twelve pieces were plated at once, these involving, in each case, one piece each of the twelve groups. After plating, the pieces were salt spray tested in the as-plated condition, without buffing.

The polishing procedures employed on each group are shown in tables 1 to 4 inclusive, including also the salt spray values found. A word is necessary in explanation of these tables as far as the polishing procedures are concerned. The operations performed are indicated by the letter X. In the case of single grain polishing, as for example, groups 1 to 4, instructions were given the polisher to remove sufficient metal to get down to a good surface. Naturally, this required more work on any one grain on the hot rolled stock than it did on the cold rolled. On the "perfect" cold rolled steel, only enough work was done to produce, in the opinion of the polisher, a finish characteristic of the grain involved.

In the case of multiple operations involving a succession of grain sizes, the operator was asked to follow the original grain with only one pass over the finer grains so as to still leave on the surface the effects of the coarser grit. In other words, in the case of the No. 9 group, for example, the purpose was to polish with a 90 grain down to a good surface and then merely "knock the tops of the scratch off" with the 220 grain. The physical appearance of the finished pieces, and a profilograph analysis of the surfaces so obtained indicated that the intended purpose had, to at least some extent, been achieved. All polishing operations indicated were done on a dry wheel, unless indicated as being a greased wheel by the letter G.

The salt spray tests were conducted and evaluated according to the method outlined by Baker⁴, a brief summary of which is given in appended sheets. The polishing grains used were analyzed to insure their correct sizing, the analyses being carried out by means of the Ro-Top Testing Sieve Shaker. These grain analyses are appended.

In addition to the salt spray tests, photomicrographs were made of typical structures found on rough and smooth polished surfaces. Also, photographs were made of sections of actual production parts illustrating certain nodular characteristics resulting from different types of

HOT ROLLED BUMPER STEEL

Group No.	Grain Used								Salt Spray Value
	90	120	150	150G	180	180G	220	220G	
1	X								20
2		X							47
3			X						47
4							X		90
5	X	X							47
6	X	X	X						53
7	X	X	X	X					97
8	X		X		X	X		X	95
9	X						X	X	105
10		X					X	X	104
11			X				X	X	92
12							X	X	71

Table No. 1

RE-CHECK ON HOT ROLLED BUMPER STEEL

Group No.	Grain Used								Salt Spray Value
	90	120	150	150G	180	180G	220	220G	
1	X								3
2		X							12
3			X						60
4							X		78
5	X	X							57
6	X	X	X						85
7	X	X	X	X					99
8	X		X		X	X		X	100
9	X						X	X	102
10		X					X	X	98
11			X				X	X	99
12							X	X	84

Table No. 2

COMMERCIAL COLD ROLLED

Group No.	Grain Used								Salt Spray Value
	90	120	150	150G	180	180G	220	220G	
1	X								58
2		X							26
3			X						41
4							X		78
5	X	X							25
6	X	X	X						37
7	X	X	X	X					80
8	X		X		X	X		X	76
9	X						X	X	87
10		X					X	X	77
11			X				X	X	71
12							X	X	70

Table No. 3

polish. And, as noted above, profilograph measurements of the surfaces were made and are shown.

Results

Tables 1 to 4 inclusive show the results of 96 hour salt spray tests, judged and evaluated, as remarked above, by the Baker method.

By reference to the appended brief description of this method, it is noted that the highest possible score attainable is 114, which would be that of a piece judged per-

<i>"PERFECT" COLD ROLLED</i>									
Group No.	Grain Used								Salt Spray Value
	90	120	150	150G	180	180G	220	220G	
1	X								60
2		X							104
3			X						105
4							X		110
5	X	X							108
6	X	X	X						111
7	X	X	X	X					108
8	X		X		X	X		X	105
9	X						X	X	102
10		X					X	X	101
11			X				X	X	112
12							X	X	106

Table No. 4

fectly free from rust for the entire duration of the test.

Table 1 shows the average salt spray value for three pieces in each group on 1085 hot rolled spring steel. Table 2, a re-check, shows the averages of six pieces in each group on the same kind of steel. Table 3, on commercial cold rolled steel, is based on the averages of six pieces of each group, and the same number of pieces per group comprised the averages shown for "Perfect" cold rolled steel in Table 4.

Discussion of Results

Considering the 1085 steel first, and with reference to Tables 1 and 2, it is first noted that Phillips results are verified. Groups 1 to 4 inclusive, representing single grain operations each, exhibit increased corrosion resistance with decreased polishing grain size. Group No. 5, being in reality a combination of groups 1 and 2 shows, as might have been predicted, a lower value than for group 4 and rather comparable with groups 2 and 3. Group 6, embodying a combination of groups 1, 2, and 3, appears to fall properly in line, when compared to the previous ones.

It will be noted that all of the rest of the groups represent panels finish polished on a greased wheel. Of these, group No. 7, was finish grease polished on No. 150 grit, the balance being finished with No. 220 grit. With the single exception of group No. 12, concerning which especial comment is required, all greased wheel finishes are superior to dry wheel finishes. Grease applied on a No. 150 wheel created an improvement over the same combination with No. 150 dry only. It is presumed, in the case of Group 7 as compared to Group 6, that additional work was done only on the tops of the scratches. Groups 9, 10, and 11 present striking evidence of improved corrosion resistance from work done only on the tops of the scratches, or work resulting in a slight lessening of the scratch depth with a rounding off or levelling of the tops. The results obtained on these three groups were so particularly interesting that Group 9 was selected for further study in an effort to determine, if possible, what fundamental reasons lay back of the improvement found. This group, it is seen, represents the combination of the two extreme sizes of polishing grain used. On visual examination, and on profilograph analysis, the No. 9 group appeared to be relatively badly

scratched. Nevertheless, it possessed good corrosion resistance because of an alteration of the size or tops of the scratches which however, still were found to be of larger size than those of the No. 8 or No. 12 groups. The fact that, in tables 1, 2, and 3, group No. 9 is given the top rating is regarded as rather incidental, as logically this group should not be superior to the other groups finished with a No. 220 greased wheel.

Before discussing the further study made of group 9, as indicated above, the corrosion test results on the other steels will be concluded. It will be recalled that group No. 12 of the 1085 steel was marked above for special comment. In the light of the balance of results, the averages found on this group appear to be unexplainably low. Of the nine pieces tested of the No. 12 group, seven pieces rated in the neighborhood of 100. The other two pieces were valued at 38 and 43 respectively. It is suspected, but not known, that these two pieces may not have been ground down completely through the outer layer of scale with the No. 220 grit and that, consequently, the early failure noted could be due to causes external to the investigation.

Considering, next, Table 3, giving the corrosion test results on commercial 1010 cold rolled steel, it is noted that the general trend is the same as that for the 1085 stock. Greased finishes show, in general, values higher than dry finishes. Also, successively finer grains result generally in improvement. The fact that Group 2 is valued smaller than Group 1 may not readily be explained, although it might be if the exact amount of steel removed in the two groups were known.

It is interesting to note that the values found for this steel as a whole are not as high as those found on the 1085 steel. It is the author's opinion that this fact is definitely associated with the inherent character of the two steels. In the actual production processing of them, pores and slag inclusions near the surface are much more often encountered in the 1010 steel. This thought is further borne out in the fact that the individual results obtained from each of the six pieces of each group are erratic whereas, with the single exception noted above, the results on the 1085 steel were quite consistent. It is therefore concluded, that superimposed on the polishing procedure effect, is the effect of basic steel imperfections. Nevertheless, the trend of results obtained is rather definitely in line with those of the 1085 groups.

Table 4, showing the results of the study on 1010 "Perfect" steel, appears at first to be a contradiction, inasmuch as all results except for Group 1 are very good. Group 1, however, does show as before, the effect of rough polish on corrosion resistance. Considering the fact that this steel was substantially free from surface imperfections and scale, it is known that less grinding was done on this stock than on either of the other two. It is therefore possible, although not known, that the scratches introduced by all grains except 90 were comparable with the finer grains only on the other steels. The fact that the above presumption is not known is admittedly a weakness existent in this research, recognized too late to remedy. Future work should embody a definite knowledge in each case, of the wheel contact time, wheel pressure, and amount of metal removed from the surface.

Exploration of Results

In attempting to explain the corrosion results obtained, groups 1, 9, and 12 were selected as being the most interesting ones for comparison. Group 8 was also considered, representing a possible commercial polishing procedure on a part requiring a No. 90 grain as a starting grit.

The upper curve of figure 1 shows a profilograph analysis of a commercial 1010 steel ground with No. 90 grain.

The lower curve in this same figure is a surface ground with No. 90 grain, then followed by No. 220 dry and 220 greased wheels. These are the surfaces representing groups 1 and 9 respectively. As a matter of interest, it should be mentioned that the vertical depth of scratch indicated, from the highest peak to the lowest depth is about 0.00008" on the No. 90 grain, with an average approximate depth of about 0.00005". The maximum vertical depth of scratch on the No. 9 group curve is seen to be about 0.00003", with an average depth of about 0.000015". Horizontally, the surface covered by the profilograph represents a distance of about 0.05".

Figure 2 shows profilograph analyses of groups No. 8 and No. 12. As would be expected, these two surfaces are similar in scratch analysis. The upper curve is of group 12, being 220 grain only. It is seen, by comparison with the curves in Fig. 1, that the maximum vertical depth of scratch is 0.00001", with an average depth of about 0.000004".

The scratch appearance represented in both curves of Figure 2 is that which is generally accepted in industry as a pleasing finish on such steel parts as bumper bars,

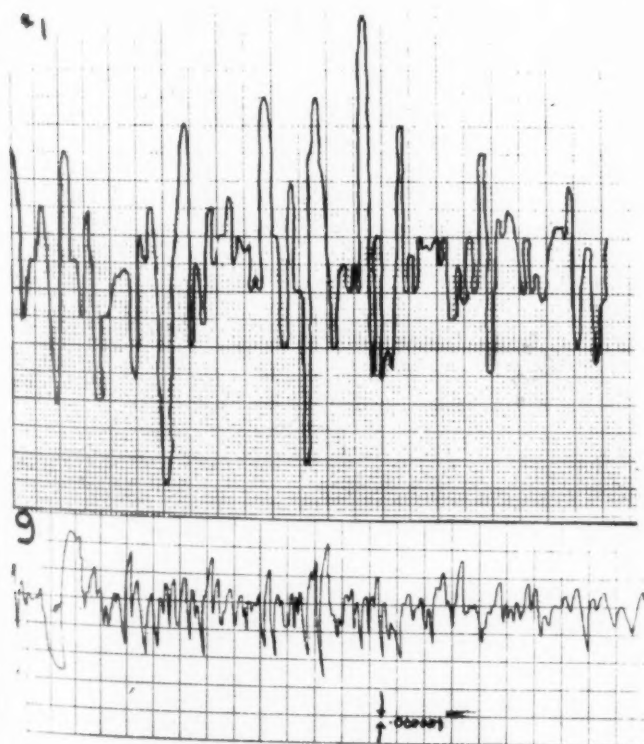


Fig. 1. (Upper) Profilograph of 1010 steel ground with No. 90 grain. (Lower) Profilograph of steel ground with No. 90 grain followed by 220 dry and 220 greased wheels.

grille bars, bumper guards and the like. The scratch appearance represented in both curves of Figure 1 is definitely not acceptable, according to existing standards of visual inspection. According to information developed in this work, group No. 1 should justifiably be condemned on the basis of both appearance and of corrosion resistance. Now, however, comparing group 9 with groups 8 or 12, the strikingly interesting point is that here have been developed two different scratch appearances, one definitely superior to the other, yet both possessing at least equal corrosion resistant properties. While it is improbable that the bottoms of the original 90 scratches in the No. 9 group have been altered by the 220 grain, nevertheless, as shown, the tops have been knocked off, reducing the scratch depths. This should also have provided for the existence of narrower scratches with areas between them more closely approaching "level" spots than originally existed.

It is proper also to particularly note the results obtained on group No. 7 as compared to group No. 6. By the addition of a 150 grain greased wheel to the surface obtained from the No. 6 group operations, marked improvement was obtained in two instances, (tables 1 and 3) and some improvement was noted in another, (table 2). Profilograph analyses of these two groups were not made; however, the physical appearance of the two groups revealed a much more scratchy surface than in group 12. Group 7 was somewhat improved in appearance over Group 6. It is probable that the cutting power of the 150 greased wheel was roughly the same as a No. 220 dry wheel.

The discussion of the profilograph curves is not complete without mentioning that the scratch depths shown are not the true depths. The needle of the instrument is, of course, dimensional and does not penetrate nor record scratches into which it cannot enter. As a consequence, all scratches may be somewhat deeper than shown or indicated. By the same token, a rounded bottom, wide scratch of a given depth would be recorded as being deeper than a narrow pointed scratch of the same depth.

The author also wishes to point out at this time that the curve representing the No. 90 polished surface is a

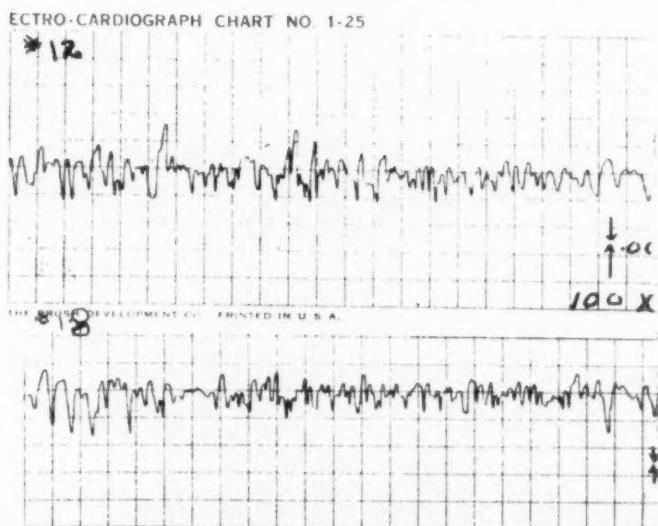


Fig. 2. Profilographs of groups No. 8 and No. 12.

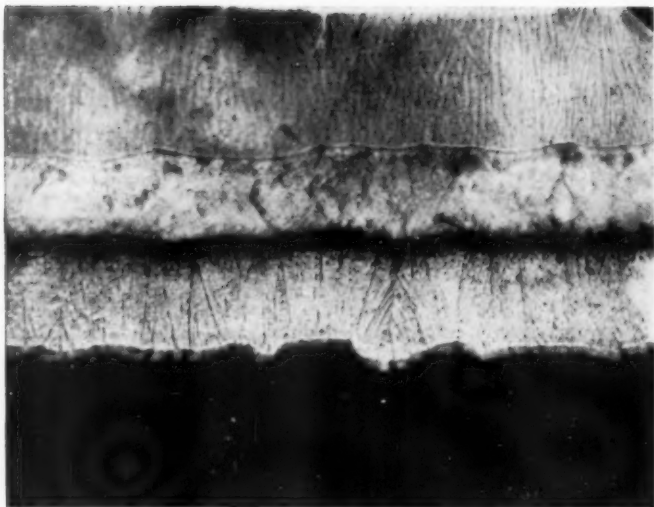


Fig. 3. Photomicrograph of nickel plate on rough polished steel. 500 x.

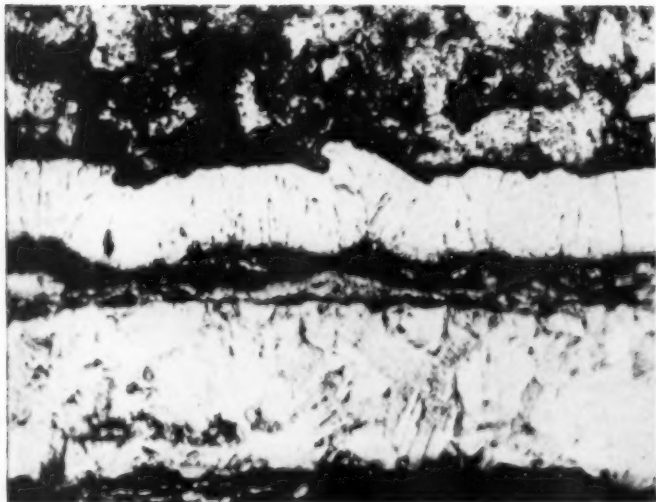


Fig. 4. Another view of nickel plate on rough polished steel. 500 x.

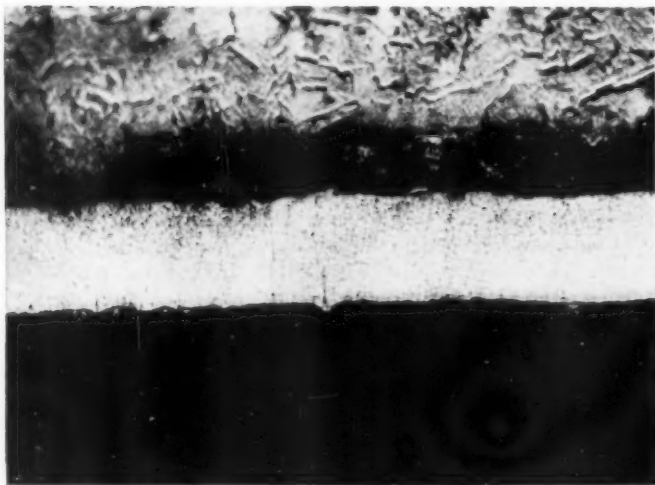


Fig. 5. Nickel plate on smoothly polished steel. 500 x.

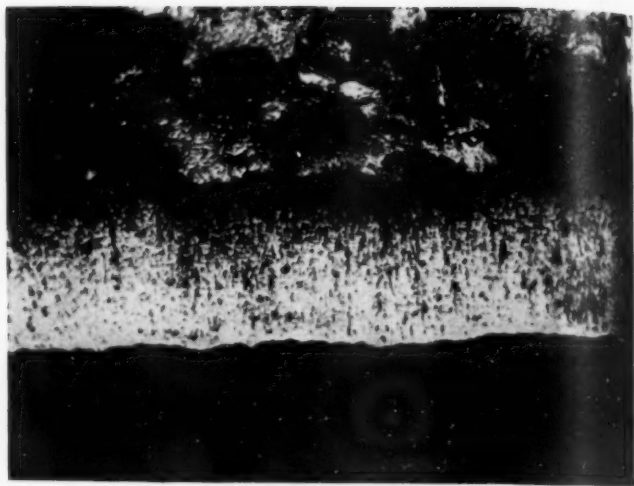


Fig. 6. Another view of nickel plate on smoothly polished steel. 500 x.

free hand enlarged duplication of the original profilograph curve. Due to a function of the instrument, it was necessary to make the original recording 1/10 the size of the other curves. Hence, for true comparison, this curve was enlarged to be of the same comparable size with the others.

In an effort to detect fundamental differences, existent in the plate over rough or smooth polished surfaces, examination was made of one panel from group 1, which rusted badly in the salt spray in 24 hours, and also of a panel from the No. 12 group, which was perfect at the conclusion of the test. At points where rusting occurred on the one piece no intelligible observations were possible as the entire structure was corroded. Certain typical crystal groupings were observed, however, and are reproduced here for such interest as they may possess.

Figures 3 and 4 are photomicrographs made at 500 diameters of the nickel plate on rough polished steel. Particularly in the deepest scratches there will be noted the distinct tendency of the nickel crystals to grow normal to the surface on which they are deposited. At such areas where the crystals join, a distinct and continuous

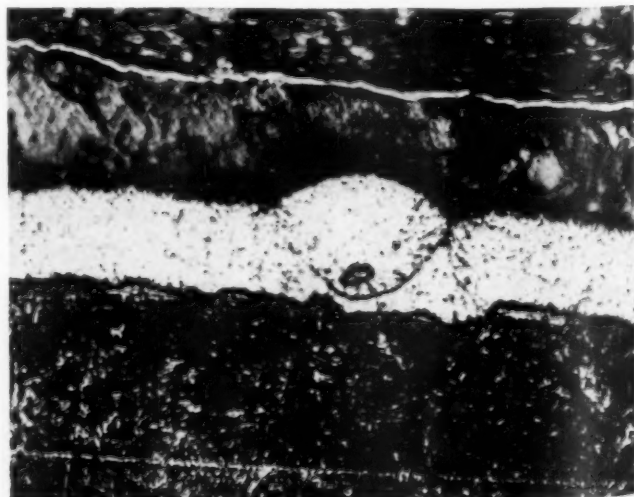


Fig. 7. Section of nickel plate containing a foreign particle inclusion.

grain boundary from the base metal to the surface of the plate, is seen.

Figures 5 and 6 show the nickel plate on a smoother polished surface. No such arrangement of crystals is seen here as was noted on the rough polished surface.

The crystalline structures of electrodeposits shown here have been previously noted by many investigators. Whether or not corrosion occurs at the grain boundaries is a matter of argument which claims adherents to both sides of the question. If those in favor of the grain boundary theory are correct, then structures such as are noted in Figures 3 and 4, possibly more accentuated, could explain the lack of corrosion resistance on such surfaces. On the other hand, the particular areas shown here did not fail on 96 hours in the salt spray. However, for the sake of argument, it is to be noted that Figures 5 and 6 are free of continuous grain boundaries. One should note particularly that in the one larger scratch shown in Figure 5, a start of this formation occurred which, however, only continued through one-half the plate thickness and was then closed or disrupted due to interference from adjacent crystal growth. Proponents of the grain boundary theory might say that this would indicate why, on a given surface, an increase in plate thickness is so important for corrosion resistance. The author regrets that photomicrographic analyses were not made prior to the salt spray test, possibly after a properly conducted ferroxyl test². Time did not permit the necessary duplication of work and the inclusion of such an investigation in this research.

In Figure 7 is shown a section of the plate, accidentally discovered, containing a foreign particle inclusion. This particle was probably metallic in nature as plating proceeded from it and structure was affected by it. Crystals may be seen growing normal to the particle surface and the interference caused by neighboring crystals results in a continuous semi-circular crystal boundary. If this boundary, amorphous in character, is low in strength such a nodule might well have been completely pulled out in buffing, leaving as seen, a very thin layer of nickel on the steel and appearing as a pit. To the right of the nodule may be seen the same crystal formation shown in Figures 3 and 4.

Incidental Observations

It has been frequently noticed in production processing of polished steel that, apparently independent of cleaning or plating procedure, certain parts would exhibit different nodular characteristics in the plate. Invariably when it was definitely known that the plating process itself was not responsible, nodulized deposits have been seen on parts where the polish scratch appearance was poor. This has been noticed on one piece of several being simultaneously plated or on certain sections of the same piece.

This characteristic has been shown by W. R. Meyer⁶, who has exhibited photomicrographs showing how a scratch in the base metal could result in a nodule in the plate.

This effect was noticed to a slight extent on the panels prepared for this research. It was notably absent on all panels, regardless of grain size used, in those groups finished with a greased wheel operation.

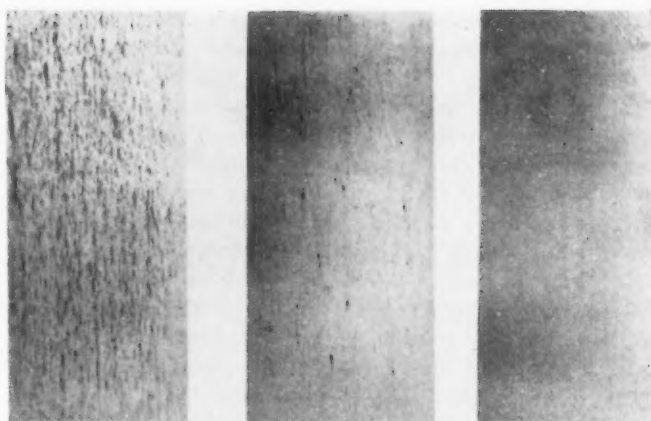


Fig. 8. Photograph of 1085 steel after plating. The plate was rubbed with a greasy rag to show up nodules more clearly. The left hand panel is steel polished with 90 grain only. The center panel was polished with 90 grain followed by 150 grain dry wheel. The right hand panel was polished with 90 plus 180 greased plus 220 greased wheels.



Fig. 9. Left hand panel polished with 90 grain only. Center panel with 90 plus 150 plus 180 greased wheels. Right hand panel was polished with 90 plus 150 dry plus 180 greased plus 220 greased wheels.

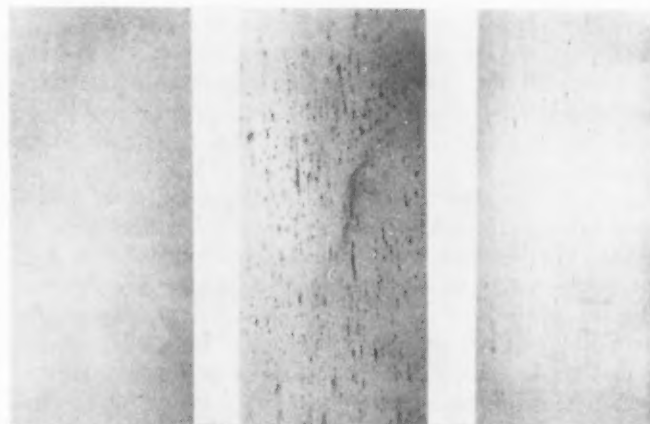


Fig. 10. Left hand panel unpolished. Center and right hand panel polished with procedure given under group 8.

Figures 8, 9, and 10 are photographs made of sections of 1085 steel after plating, to illustrate the points noted. The nickel plate on these sections was rubbed with a greasy rag after plating in order to show up nodules in the plate more clearly. The left hand panel of Figure 8 is one end of a piece of steel polished with 90 grain only, whereas, the center panel of this figure is the other end of the same piece of steel, polished with 90, followed by a 150 dry wheel. The right hand panel is a plated piece which had been polished with 90 plus 180 greased wheel plus 220 greased wheel. In Figure 9, the left hand panel is polished with 90 grain only. The center panel is the other end of the same piece polished with 90 plus 150 plus 180 greased wheel. The right hand panel of this group is polished with 90 plus 150 dry, plus 180 grease, plus 220 grease. In the above two figures the effect of polish on nodule formation is rather clearly demonstrated. In Figure 10, the left hand panel was unpolished, hot rolled 1085 steel, whereas the center and right hand panels were two pieces plated at the same time, which had been polished in accordance with the procedure given under group 8. Here again is shown, even on hot rolled steel, the damage which may be done by polishing as far as nodule formation is concerned.

Tentative Conclusions

It was stated at the outset that the author considers the data presented as being incomplete and that, to be accepted as established facts, should be substantiated by much more elaborate and detailed work than is presented here. Hence, the heading "Tentative Conclusions" to this section of the paper. The conclusions reached by other investigators already mentioned is substantiated that polish on the base metal does have a real effect on corrosion resistance and character of nickel plate. Also, as mentioned by many before and established inferentially here, pores, scale and similar imperfections in the base metal, exert a profound effect on the properties of the plate.

However, if the results here published are verified, something else besides scratch depth apparently enters into the picture. While the exact definition of harmless scratches is unknown, indications are that some relation exists between corrosion resistance of the plate and scratch shape or width and, within certain limits, independent of depth.

Further, if these results are verified and are extended, then it may be possible to define fundamental causes of many failures or improvements developed in the plating industry. If the crystal boundary theory is correct, one can clearly understand why, for example, no polish on a good cold rolled finish is better than a polished finish. Superior results obtained by high finishes on steel are explained, likewise superior corrosion results on buffed copper under nickel. The poor corrosion resistance of nickel over sand blasted steel is also explained.

On the other hand, considering group No. 9, poor scratch appearance need not necessarily involve that the piece is poorly corrosion resistant. It would appear, from the data here published that a certain amount of work with a fine grain plus grease is of major importance. A full substantiation of these results would apparently lead to the conclusion that scratch elimination is not definitely necessary as long as a smoothing effect is

obtained on the scratch tops inevitably combined with some diminution of scratch depth and width.

If the above statements are verified and if sales resistance to slightly more scratched appearing articles could be overcome, additional possibilities to the economical use of bright nickel would be created.

Generally speaking, bright nickel is now applicable to articles in which no coarse polishing scratches are evident. It is rather well known that to "smooth out" polishing scratches in bright nickel is a more costly buffing operation than a similar attainment on grey nickel. Now, however, if these polishing scratches are correctly handled as indicated above, it is probable that the protective value of bright nickel should be as good as that of Watts nickel on such surfaces. This assumption should, of course, be verified and if found to be true one further step toward the more extensive use of bright nickel will have been created.

In conclusion the author wishes to gratefully acknowledge the assistance of Mr. Lewis of the Production Research Division of the Chrysler Corporation for making the profilograph analyses. The author is also grateful to his own associates in the Houdaille-Hershey Corporation for their assistance in this research.

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1. "The Causes of Porosity in Electrodeposited Coatings." Hother-sall and Hammond, Trans. Electrochem. Soc. 1938.
2. "Effects of Polishing on Corrosion Resistance." Wm. M. Phillips, Trans. Am. Electroplaters' Soc., 1936.
3. Paper presented at Chicago Branch (A.E.S.) Meeting 1939.
4. "Rust Resistance of Nickel Plated Steel." E. M. Baker, Jour. S.A.E. 1924.
5. "Experiences in Evaluating Plated Coatings," Pinner and Sperry, Trans. A.E.S., 1937.
6. "The Orientive Effects of the Geometrical and Crystalline Structure of the Cathode on the Crystal Structure of Electrodeposits," Walter R. Meyer, Proceedings Annual Meeting of A.E.S., 1936.

Appendix

Baker Method⁽⁴⁾ of Salt Spray Evaluation

This method is based on an inspection at 8 hour intervals, rating the pieces as follows:

- "P" Perfect—No trace of rust can be detected on closest scrutiny.
- "VSR" Very Slightly Rusted—A very close examination just showing traces of rust.
- "SR" Slightly Rusted—A close examination would show distinct signs of rust.
- "NR" Noticeably Rusted—A moderately close examination would show presence of rust.
- "VNR" Very Noticeably Rusted—The rust would be plainly discernible at a distance of 3 or 4 feet.

The numerical values are arrived at according to the following table:

Appearance	SALT SPRAY VALUES—at hours shown										
	8	16	24	32	40	48	56	64	72	80	etc.
P	4	5	6	7	8	9	10	11	12	13	
VSR	3	4	5	6	7	8	9	10	11	12	
SR	2	3	4	5	6	7	8	9	10	11	
NR	1	2	3	4	5	6	7	8	9	10	
VNR	0	0	0	0	0	0	0	0	0	0	

As an example, if the salt spray appearance in 8 hour intervals is rated as being:

P P VSR VSR NR VNR
The values are: 4 5 5 6 5 0 equals 25

Polishing Grain Analyses

	Specification % Allowed	On Sieve	Actual Found
No. 90 Grain	None	70	0.4
	15% Max.	80	8.2
	40% Min.	(100)	55.3
	70% Min.	(120)	33.3
		140	2.6
	3% Max.	Pan.	0.2
No. 120 Grain	None	100	0.4
	15% Max.	120	5.4
	30% Min.	(140)	45.4
	60% Min.	(170)	34.0
		230	13.2
	3% Max.	Pan.	1.6
No. 150 Grain	None	100	None
	15% Max.	140	1.8
	40% Min.	((170))	19.0
		((200))	46.3
	75% Min.	(230)	12.8
		Pan.	20.0
No. 180 Grain	None	120	None
	15% Max.	170	0.2
	40% Min.	((200))	41.9
		((230))	4.2
	65% Min.	(270)	26.1
		Pan.	27.7
No. 220 Grain	None	140	0.1
	15% Max.	200	7.5
	40% Min.	((230))	2.7
		((270))	21.7
	60% Min.	(325)	52.1
		Pan.	15.7

Treatment of Plating Room Waste Water

(Concluded from page 71)

to the bottom of the tank or raised to a height of approximately six feet. This enables the top, or clear, water to be decanted down to the slurry line and discharged into the sewer system. The slurry is then pumped through another drain pipe from the bottom of the treatment tank into a filter press, from which it can be removed in cake form and easily disposed of.

Chemical Control

The procedure of analysis that we have set up at the treatment plant is rather simple, and does not require an experienced chemist. The first procedure is to make a pH determination of the sample, and calculate the amount of acid necessary to lower the pH to 3 or below. It was found that the most satisfactory results were obtained by making the barium sulphide additions at a pH of 3 or lower. The calculated amount of acid is then added to the treatment tank and agitated for at least five minutes, when another sample is taken. This sample is then tested with barium

sulphide in test cylinders, to determine the amount required to reduce the yellow color to green. A set of color standards was made up to give an indication of the amount of barium sulphide required. After sufficient barium sulphide has been added to reduce the yellow color, the pH is again determined, and enough lime is added to raise the pH to 6 or above. This forms a fairly heavy floc, and the solution settles clear and colorless.

After satisfactory test treatments have been secured, the amount of barium sulphide and lime necessary to add to the treatment tank are calculated from these tests.

The required amount of barium sulphide is then dissolved in hot water. Two mixing tanks have been installed in the treatment building for this purpose, as previously stated. One of these tanks is a 400-gallon round wooden tank, with an agitator, and is used for dissolving the barium; the other is a 100-gallon wooden tank, used mostly for dissolving lime. These tanks are piped to a common centrifugal pump, in order that the solutions may be pumped into either of the treatment tanks. The barium sulphide solution is then pumped into the treatment tank while stirring, and stirring is continued for at least five minutes. The calculated amount of powdered hydrated lime is then suspended in the smaller solution tank to make approximately 10% suspension. This is then pumped into the treatment tank and stirring is continued until the floc coarsens. The process requires approximately another five minutes.

The treatment tank is now permitted to settle for at least one hour, after which the filter press pump is started, pumping the settled slurry into the press. The decanting of the top water may be started as soon as the slurry settles below the top of the drain. This generally takes two to three hours, but we have found it more satisfactory to permit the solution to settle overnight, decanting the top water the following morning.

The above procedure has been found to operate quite satisfactorily by filling and treating one tank while the second tank is being decanted and filtered. Under this procedure, each tank completes its cycle every other day.

Automatic Equipment for Plating

(Concluded from page 75)

aluminum arms, each carrying two or more plating racks.

The manufacturer who has been under the impression that it requires a large production of a similar type of work to warrant the installation of automatic dipping equipment, may find that among the many designs offered there is one that exactly meets his own plant requirements. Automatic finishing means increased production at lower costs, more uniform results and more orderly premises, making for better housekeeping and improved working environment.

EDITOR'S NOTE: For supplying helpful data as well as for the loan of pictures used in this article, we gratefully acknowledge the courtesy of the following manufacturers:

Hanson-Van Winkle-Munning Co., Matawan, N. J.
The Meaker Company, Chicago, Illinois,
Frederic B. Stevens, Inc., Detroit, Michigan,
LaSalco, Inc., St. Louis, Mo.,
U. S. Galvanizing and Plating Equipment Corp., Brooklyn, N. Y.

Brightening Gold Rings

Q. We are often faced with the problem of brightening deep sections in the head of gold rings, which have been cast, where it is impossible to get at with a polishing brush and not practical to tubing. We know that it is possible to accomplish what we are after, as we have seen excellent results on rings manufactured in the U. S. A.

From the information we have been able to gather, so far, we think that the best method for removing this fire scale or oxidation is by stripping electrically using a suitable acid or cyanide composition in solution. We have experimented with several formulas from various publications on electroplating and the results obtained were far from satisfactory.

In some cases the action was just the reverse to what we wanted. That is the rings came out almost black. In others, the action on the metal was too strong, so that by the time the rings showed signs of becoming bright they had lost too much in weight. Also the action varied on the various colors and carats of gold. We would greatly appreciate any information that might solve this problem for us or if you can recommend any prepared compound that is on the market, it would simplify the whole thing.

A. Stripping of cast gold rings can be done successfully in a solution of sodium cyanide with reverse current. The alloys used in cast gold occasionally are the cause of black areas, particularly in piercings and indentations, more so if a small cathode area, low temperature and insufficient cyanide are present in the course of stripping. Trouble is also encountered endeavoring to strip too many pieces at one time.

In stripping cast gold, greater amounts of the ingredients that constitute the stripping solution formula are used. Owing to the small volume of solution generally used in the jewelry industry, and with greater concentrations of cyanide, etc., higher temperature and high current, the solution upon use and evaporation changes rapidly from its original formula, causing rough and black surfaces on the rings. A constant solution level and temperature, steady flow of current and cyanide concentration should be maintained.

Too high cyanide content results in fast uneven stripping with a great loss in weight of the rings. In average stripping, the loss in weight of a ring is from 1 to 5 grains, depending upon size.

I suggest that after pickling in a boiling 10% solution of sulphuric acid for a few minutes (this is essential) cold water rinse,

Technical Advisors For February Issue

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Shiman Mfg. Co.,
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then strip the rings using the following formula:

Sodium cyanide	6 ozs.
Rochelle salts	3 "
Potassium ferrocyanide	3 "
Water	1 gal.

Temperature 190°F., 6 volts, reverse current, sheet iron cathode. Stripping time 15 to 60 seconds with slow agitation of work.

For assurance of bright, clean and even stripping, emphasis should be made to the controlling factors of the stripping solution formula.—P. A. O.

Scale On Pewter

Q. In the silver plating of the inside of antique articles, particularly pewter, there seems to be a scale or oxide, and the article is pitted.

Scratch brushing or other methods of cleaning do not seem to remove this scale sufficiently to allow silver to adhere to the metal.

What would you suggest for removal of this?

A. If this is a problem of refinishing, some of the trouble comes from the absorption of some of the old deposit by the base metal. This, plus the corrosion pits that have developed with standing or use of the article require that the surface be cut down.

Sand bobbing is the most effective way of accomplishing the cutting down. Use a sewed muslin buff with 0½ pumice that has been very lightly moistened with a vegetable or light mineral oil. Then tripoli buff, or scour with pumice and water for a dull finish.

If the pits in the base metal cannot be removed by the above operations some trouble will be had in the silver plating. This is because the pits have become filled

with composition, or smut, and prevent the silver from depositing, but the high cyanide of the solution is enough to cause chemical attack at the pit so that it is opened up more.

Relief from such a condition can be had by doing all possible to have the pitted portions clean before going into the silver strike. After coloring with grease composition, clean the article in a solvent and wipe dry. Then scratch brush with a fine wire wheel, and use clean soap bark water liberally. This will effect most of the cleaning necessary so that alkaline cleaning before plating can be very mild. Excessive alkaline cleaning should be avoided as a smut will be produced in the pitted portions and you will be back where you started. For good cleaners for this purpose, consult manufacturers who advertise in METAL FINISHING.

The treatment after cleaning will vary depending on the base metal. If an acid dip, such as 10% hydrochloric acid is used, the time of immersion should be short to avoid smut formation.

After silver striking, examine the article to note if all portions are uniformly covered. If spots are evident, rinse, and scratch brush with soap bark water, and strike again until complete covering has been obtained. Then silver plate.—G. B. H., Jr.

Faulty Nickel Solution

Q. We are mailing you a sample of our still plating nickel solution. This solution has been in operation for approximately eight months, and has produced excellent results. It is now failing in these respects. The edges of small articles turn black or "burned" and the center parts seem too brittle and flake off. This solution is operated at room temperature. The work is brass and steel and finished in chromium. The cleaning and other operations are done correctly. We feel certain our trouble is in the nickel solution.

The solution was made up according to Blum & Hegaboom's, "Principles of Electroplating," double nickel salt plating solution. This tank contains 187 gallons of solution using 95%-97% nickel anodes. Please advise us as soon as possible what corrections or additions we could make to make this solution usable.

A. The analysis of your solution shows the following:

Nickel	1.88 ozs./gal.
Ammonium chloride	1.49 "
pH	4.8

(Continued on page 86)

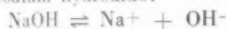
Fundamentals of Science Relating to Electroplating

Chapter 6

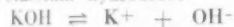
The discussion of acids brings up the very important subjects of pH and indicators, terms now well known and essential to the electroplater. So as not to interrupt the present trend of thought, however, these two subjects will be treated in an appendix to this article.

The development of the conception of a base was parallel and similar to that described previously for an acid, and, carrying this similarity further, a *base* may be defined for our purposes as a substance that can furnish OH^- , called the *hydroxyl ion*, in aqueous solution. This characteristic common to all bases (alkalies) is evident from the following:

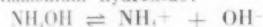
Sodium hydroxide:



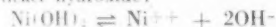
Potassium hydroxide:



Ammonium hydroxide:



Nickel hydroxide:



Some substances have the OH combination in their formula (for example, ethyl alcohol $\text{C}_2\text{H}_5\text{OH}$) but these do *not* form the hydroxyl ion (OH^-) in solution, so they are *not* bases and do not act like bases.

Notice that bases are really combinations of the hydroxyl group (OH^-) with a metal, the ammonium ion (NH_4^+) being included in this class because of its similar properties. The bases, known also as hydroxides, may be considered as combinations of metal oxides with water, for example, calcium hydroxide [Ca(OH)_2] being a combination of calcium oxide (lime, CaO) with water. This is analogous to the non-metallic oxides (acid anhydrides) forming acids with water.

TABLE III

Properties of Acids and Bases

Acids

- Sour to taste.
- Non-slippery to feel.
- Change indicators to certain colors.
- Conduct electricity and are decomposed by it.
- Can form hydrogen ions in water.
- Neutralize bases.
- Are combination of (a) hydrogen with non-metal, or (b) non-metallic oxide with water.

Bases

- Bitter to taste.
- Slippery to feel.
- Change indicators to different colors than acids do.
- Conduct electricity and are decomposed by it.

Chapter 6 concludes the discussion on the properties of acids and bases. Hydrogen ion concentration and indicators are briefly considered.

Can form hydroxyl ions in water.

Neutralize acids.

Are combination of metal oxide with water.

In both acids and bases, those substances which ionize extensively, giving high concentrations of hydrogen ion or hydroxyl ion, are respectively *strong acids* or *bases*; those of a medium degree of ionization are moderately strong acids or bases, etc. Table IV gives some of the acids and bases of importance to platers:

TABLE IV

Acids and Bases Used by Platers

Acids

Strong—Hydrochloric, nitric, sulfuric (known also as the mineral acids).

Moderately Strong—Phosphoric, hydrofluoric, acetic, oxalic, formic.

Weak—Boric, carbonic, hydrocyanic acids, Hydrogen sulfide.

Bases

Strong—Sodium, potassium, barium and calcium hydroxides.

Moderately Strong—Ammonium hydroxide and some organic derivatives, silver, copper, cadmium and nickel hydroxides.

Weak—Aluminum, chromium and ferric hydroxides.

Water, which ionizes to an extremely slight extent, may be considered both a weak acid and a weak base since:



The reverse of this reaction, which takes place to almost 100%, shows the most important thing that happens when bases neutralize acids (or vice versa):



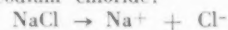
i.e. the hydroxyl ion of the base always combines with the hydrogen ion of the acid to form water and this happens because of the very strong inclination of water to be un-ionized.

The other compound that forms as a result of mutual neutralization is a salt, which checks the historical conception described above. A *salt* is now defined as a substance containing a positive ionizing atom or radical (not hydrogen) combined with a negative ionizing atom or radical (not hydroxyl). The hydrogen and hydroxyl

group may be present but only in addition to the other atoms or radicals.

From this definition, it is not only the result of the neutralization of an acid and a base that is called a salt. Salts may also be formed by the action of metals on acids. (See next chapter on Chemical Reactions). In fact, acids at one time were defined as substances containing hydrogen which could be replaced by metals to form salts. Examples of salts are common:

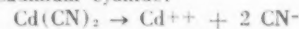
Sodium chloride:



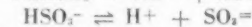
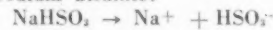
Nickel sulfate:



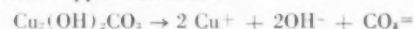
Cadmium cyanide:



Sodium bisulfite:



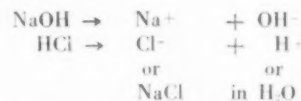
Basic copper carbonate:



When a hydrogen ion is formed as a result of the ionization of a salt, as in the case of sodium bisulfite, the latter is called an *acid salt*. Similarly, when the hydroxyl ion is formed, as in the case above of copper carbonate, it is called a *basic salt*. With neither of these ions formed, as in the first three illustrations above, the substance is a *normal salt*. With a few exceptions (as in the case of mercury and cadmium) salts in general are considered to ionize 100%.

The formation of salts from acids and bases can perhaps be best visualized by noting the following:

In water:



If the water is evaporated, only sodium chloride (NaCl) is left. Other characteristics of salts, as well as of acids and bases, will be described in the next chapter under Chemical Reactions.

Appendix To Acids, Bases And Salts—pH

The concentration of hydrogen ions in a given solution, as we have seen, determines the "intensity" of the acidity in that solution. For example, if equal weights or even equivalent weights of boric and sulphuric acids were added to a nickel solution, the plating results would be entirely different in each case because the concentration of the hydrogen ions furnished by these two acids would be entirely different, or in other words, one is a weak acid and the other a strong acid. The plater has already

been taught to say: "The pH would be different." For our purposes, we may think of pH as a measure of the hydrogen ion concentration. The use of this term and the significance of pH numbers come about in this way.

We have mentioned that water ionizes to a very slight extent. In very pure water (H_2O), i.e. neutral water, at room temperature, the concentration of hydrogen ions is only about 0.0000001 normal. (The term "normal" will be discussed in the next chapter. For hydrogen, it means 0.0000001 gram per liter). In mathematics, this number is conveniently written 10^{-7} and the number 7 is called the pH of the solution since it is only necessary to know this number to be able to compute the hydrogen ion concentration. Since this figure of 7 was obtained on neutral water, and since every neutralization between acid and base really means the reaction:



a pH of 7 signifies a neutral solution. A pH higher than 7 indicates an alkaline solution and a pH lower than 7 indicates an acid solution. A $\frac{1}{2}\%$ hydrochloric acid solution is 0.14 normal and its effective ionization is more than 90%. The hydrogen ion concentration is therefore 0.12 normal. This number may be expressed in mathematics as 10^{-91} . The pH of this solution is therefore 0.91. In a similar way, the pH of any solution may be derived, or knowing the pH, the hydrogen ion concentration can be figured.

There are a few peculiarities about pH numbers. Notice, for example, that the *lower* the pH, the *higher* is the acidity. The reason for this is evident from the above or by taking a simple example. Thus pH 4 means 10^{-4} or 0.0001 (4 decimal places) normal in hydrogen ions. pH 2 means 10^{-2} or 0.01 normal which is 100 times the acidity of pH 4. This example illustrates another feature. Each *unit* change in pH (as from pH 3 to pH 2) means a *ten-fold* change in acidity, so that the decrease from 4 to 2 in the above example meant an increase of 10×10 or 100 times in acidity.

Methods of measuring pH, in the plating industry, are commonly of two types. The most common is a colorimetric method using standard solutions, glass discs or paper. The other, which came into vogue when the pH of cyanide baths like the Rochelle copper was learned to be important, uses an electrochemical system with a glass electrode. The plater is familiar with both these methods, which cannot be discussed in further detail here. They have been well described in the literature. (See for example an article by Hall and Hogaboom*).

Indicators

In Table III above, one test for acids and bases was the color they produced in indicators. An *indicator* is an organic dye, the color of which depends on its pH. The extract from the litmus plant, for example, is blue at a pH above 8 and red below a

TABLE V
INDICATORS USED BY PLATERS

pH range	Common name of indicator	Color change
0.2-1.8	Acid Cresol Red	Red to Yellow
1.2-2.8	Meta Cresol Purple	Red to Yellow
2.6-4.2	LaMotte Yellow	Red to Yellow
3.0-4.6	Bromphenol Blue	Yellow to Blue
3.8-5.4	Bromcresol Green	Yellow to Blue
5.2-6.8	Bromcresol Purple	Yellow to Purple
6.0-7.6	Bromthymol Blue	Yellow to Blue
6.8-8.4	Phenol Red	Yellow to Red
8.0-9.6	Thymol Blue	Yellow to Blue
9.6-11.2	LaMotte Purple	Purple to Red
11.0-12.6	LaMotte Sulpho-Orange	Yellow to Deep Orange
12.0-13.6	LaMotte Violet	Violet to Blue

pH of 5 with the color changing quite definitely between 6 and 7. Since a solution with a pH above 7 is alkaline, a solution turning litmus blue is an alkaline solution. Similarly, a solution turning litmus red or pinkish is an acid solution. If acid is added to an alkaline solution containing litmus, the solution will be just neutral when the color changes from blue to red (and is approximately purple). In this way, by using measured amounts of acids and bases of known strength, and with proper indi-

cators, the amount (but not the intensity which is pH) of base and acid, respectively, present in a solution can be determined. Such a procedure is called a *titration*. A table of the more common indicators of interest to platers, with their colors at various values of pH, is given below (Table V). By using such indicators and knowing their colors at different values of pH, the pH of a solution may be determined and this is the basis of the colorimetric method of pH determination mentioned above.

Shop Problems

(Concluded from page 84)

If the original formula you used was as follows:

Double nickel salts	10 ozs.
(Ni about 1.5 ozs.)	
Ammonium chloride	2 "
Boric acid	2 "
pH	5.8
Water to make	1 gal.

Then the nickel content has gone up, and the chloride content down. Also, your pH now is quite low.

To correct the pH, you need about 27 fl. ozs. of ammonia to the whole tank. This would be the first thing to do. If brittleness continues, then the temperature is too low, or you have impurities such as lead, zinc, or copper in the solution. The temperature should be 65 to 75° F.

Impurities can come from work dropped to the bottom of the tank and allowed to stay there, or from plating zinc work. This solution is not good for plating die castings.

Further, it is suggested that if you wish at any time to increase the nickel content, that only single salts be used. Double salts are falling into disuse due to their limited solubility. For the same reason, it would be advisable if you wish to increase the chloride content, to do so with nickel chloride. This will avoid increasing the ammonium content with consequent increase of double salt tendency to crystallize out.

—G. B. H., Jr.

Copper Analysis

Q. We have been using your "Plating and Finishing Guidebook" for a number of

years and especially your "Methods for Analyzing Plating Solutions." However, we have been repeatedly stumped in our efforts to ascertain the metallic copper content of our cyanide copper bath as directed on page 95 of your 1940 issue. If we get the dark blue color, we get nothing right after that. We shall be glad if you can give us a copy of any literature which more fully cover this particular analysis. We have most of the regular text books published but none of them give the information in the clear way your guidebook does to the non-trained chemist. If you cannot send any literature perhaps you might be able to say why we cannot get the light blue or bluish-green color in our solution after the addition of 30% acetic acid to the boiled dark blue solution.

A. In the copper analysis, the acetic acid is added for two reasons. First to provide the correct acidity for titration with thio-sulfate and second to keep the iron precipitated as ferric acetate, since if the iron remains in solution, which would be the case if a mineral acid such as hydrochloric or sulfuric acid were added, the results would be affected.

The acid is added to the boiled solution which has a deep blue color due to the copper-ammonia complex formed by the addition of ammonia before boiling. If too much ammonia is present there is not enough acid added to neutralize it and the blue color will not be discharged. You can check to see if this is the trouble by adding more than 10 cc. of 30% acetic acid. If the deep blue color is discharged you are adding too much ammonia.

Only enough ammonia should be added to the sample to form the deep blue.

—G. B. H., Jr.

*Metal Industry (now Metal Finishing) 37, 270 (1939).

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

Copper Core Chromium Plating Anode

Hartzell Mfg. Co., 205 Hickory St., Dayton, Ohio, have developed a copper core lead anode for chromium plating. The anodes have a one-piece copper hook which will accommodate round anode rods up to 1½" diameter; special hooks for ½" x 2" flat bus bars are also available.

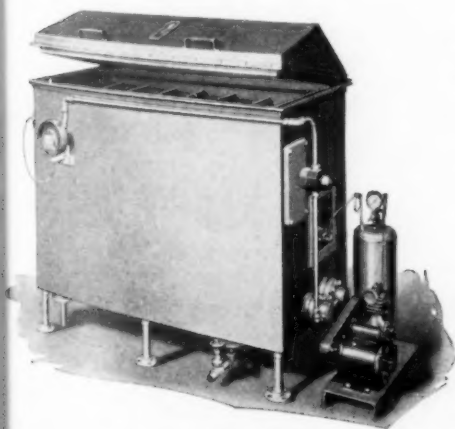
It is claimed that perfect bond of the lead to the copper core is made and the copper hook is protected from corrosion. The copper core is insulated from the lead casing, above and below the solution level, preventing burning off at the solution line. The complete current saturation of the lead casing from top to bottom is said to give equal distribution of current with unusual throwing power.

The anodes are angled to give more current carrying edges. This feature plus the copper core construction are said to reduce the electrical resistance from both polarization and from metal resistance. The anodes are made in any length from 20" to 48".

Salt Spray Test Equipment

Industrial Filter & Pump Mfg. Co., 3017 W. Carroll Ave., Chicago, Ill., are building and supplying to the trade, salt spray corrosion equipment for testing at controlled temperatures to conform with army, navy and aeronautical specifications on electroplated parts as outlined in Bulletin AN-QQ-S-91-5 dated December 1938.

The units are designed to test the corrosion resisting qualities of electroplated or other coated metal, alloys, organic finished parts, etc., using salt spray. The equipment is supplied with temperature control so that tests can be conducted to specifications at controlled temperatures from 65 to 95 degrees F. Units can also be supplied without temperature control.



Salt spray test equipment

The temperature control is made by close adjustment of a switch which controls immersion heaters within the salt water compartment of the cabinet. The heated salt water, when atomized, creates the desired temperature within the testing chamber.

The testing cabinet is completely covered on the inside with ⅛" thick rubber; spray tips are made of glass and can be adjusted to density of spray required. Air compressor is driven with 1/3 H.P. motor, developing 1½ cu. ft. of air per minute and 9 lbs. of continuous pressure.

Standard sizes are from 24" long x 15" wide x 30" deep, to 48" long x 30" wide x 36" deep.

Asbestos Filter Material

Industrial Filter & Pump Mfg. Co., 3017 W. Carroll Ave., Chicago, Ill., have announced a new product called "Filterbestos", which is a processed fibrous filter material for use in filtration.

The product is usually used alone, but it is said that exceptionally good results are also obtained by using the material as a pre-coat and by adding filter aids to the liquids being filtered.

Advantages claimed for the use of the material are: uniformity and stability of filter layer without weak spots; no breakdown of filter layer; and greater brilliancy of filtrate. The use of the material is said to offer cleanliness of operation as the exhausted filter layers peel off in one single piece, keeping the supporting cloths or screens clean, thus saving labor and material.

The manufacturer will gladly recommend the proper grade and use of the material in connection with the inquirer's needs.

Rubber-Lined Outlet and Overflow Valve

Further improvement in the method of handling acids used in steel pickling operations is announced by The B. F. Goodrich Company, Akron, Ohio as a result of its development of a new combination outlet and overflow valve for these tanks.

The new product is a modification of the patented rubber-lined Vulcalock valve developed by Goodrich for handling corrosive and abrasive fluids.

Installed entirely on the outside of the tank, the outlet and overflow installation uses a wheel and screw attached to the valve stem to raise and lower the valve disc. It can be fitted to existing pickling tanks, or built into the construction of new ones. Provision is made for automatic overflow at a predetermined level, thus maintaining constant liquid level in the tank.

Among the principal advantages claimed for the new method is the ease and rapidity with which the valve can be operated and the solutions completely drained from the tank, any accumulated sludge being carried away rapidly and completely, with a minimum of flushing.

Previous methods used have been siphoning, or discharge through a removable drain plug installed in the tank's bottom. With a siphon, much labor with hose and shovel was required to remove the sludge. In the second system the drain plug often proved an obstruction which was caught and jarred loose by the steel being handled in the pickling vat, with resultant loss of acid.

The new valve, completely rubber lined, is fitted with a low-cost replaceable, resilient, rounded disc which snaps over a circular plate at the lower end of the stem and provides an absolute seal when brought into contact with the rubber-covered seat ring.

Galvanized Sheet for Painting

The Newport Rolling Mill Co., Newport, Ky., has announced the addition of a new product called "Colorbond" to its list of products. This is a galvanized sheet which has been subjected to chemical and metal-

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lurgical processes that change the surface finish to enable durable and satisfactory adhesion to be obtained with organic finishes, such as paint, enamel, varnish and lacquer when applied to the surface.

The processed sheet is said to offer a "tooth" to the finish and thus dual protection is offered to the base metal, namely, protection by the organic finish and by the zinc coating.

The usual peeling difficulties experienced with organic finishes on top of galvanized coatings are said to be obviated and thus maintenance costs from repainting are reduced. The sheet is said to be easily fabricated and formed without special tools and is made in three base metals, namely: iron copper, copper steel and the company's "Globe" brand steel. It is available in all sizes and gauges.

Monel Chain for Pickling

According to the International Nickel Co., 67 Wall St., New York City, a Mid-West plant

of a large producer of steel tubings has obtained ten years' service with Monel chain that had to withstand 6 to 8 per cent sulfuric acid solutions at 180°F.

The chains are used to carry steel tubing through pickle and rinse, are 19' long and are made of 13/16" diameter hot rolled Monel rods. The life of the chain is claimed to be longer than that of other materials used, and has shown marked freedom from extensive repair. It is also stated that scrap value of the chains is high, even after long service.

New Skin Protection

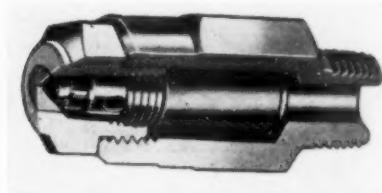
The Milburn Co., Detroit, Mich., have announced a new formulation known as "Ply No. 9", which has been created specifically for industries where perspiration of the hands is injurious to both workers and products, such as the manufacture of high-precision bearings or airplane parts where normal perspiration may cause rust spots. The product

is available in the form of a water-like colorless solution and the worker dips his hands into it and permits the moisture to dry, and as it does, the material forms a very fine, invisible film, which is claimed to offer dual protection; one for the worker and the other for the product on which he is working.

Clinical tests have shown that the material causes a rapid drop in perspiration accumulated on the surface of the skin. It is said to be harmless to the body, inert to metals and persons, and to be easily removed.

Hydraulic Atomizing Nozzles

The illustration shows atomizing spray nozzle just placed on the market. Spray pattern is hollow cone with uniform distribution and atomization is claimed the finest possible and the most complete that can be had with relatively low hydraulic pressure alone. Nozzles are of sturdy construction, accurately machined with polished orifice insert and are now available with male and female 1/4" pipe con-



Hydraulic atomizing nozzle

nection. Capacities range from 1.2 to 17 gallons per hour at 60 pounds pressure. Standard stock construction is brass with 18-8 stainless steel insert for orifice and core tip and Monel metal strainer built in; also, 18-8 stainless steel throughout—other materials can be specified.

Nozzles are to be used for spraying water, oil and other liquids with similar viscosities.

Made by Spraying Systems Co., 4019-21 W. Lake St., Chicago, Illinois.

Midget Pressure Pump

Eastern Engineering Co., 45 Fox St., New Haven, Conn., have announced the addition of a new model to their line of midget size pumps. The pump, called "Model UT", is said to be compact, self-priming and capable of high pressures. Its performance is 3 gal-



Small size pressure pump

lens per minute and maximum pressure 35 lbs. per sq. in. It weighs 3½ lbs. and is run by a 1/20 H.P., 115 volts, A.C. or D.C., universal fan cooled type motor. The pump unit is chromium plated bronze.

This pump is said to be ideal for any application in which the location of tanks and containers makes the self-priming feature essential. Its light weight and small size make it particularly adaptable to all installations requiring the pumping of thin liquids where weight and space involved must be kept at a minimum.

Remote Pneumatic Transmission Systems

Taylor Instrument Companies, Rochester, N. Y., have developed a new remote pneumatic transmission system for indicating, recording or controlling process variables remote from the point of measurement. This system is said to be particularly advantageous where it is desirable to correlate temperature, pressure, flow or liquid level data on a centralized panel or in a control room.

It may consist of one or two transmitters connected to a receiver, or one or more receiving instruments, not necessarily near each other, and as far as 1000 feet from the transmitter. Transmitters or receivers may be indicating, recording or controlling types. Air pressure is the transmitting medium, with ¼" O.D. copper tubing as the means of connection.

The manufacturers report this system to be highly accurate, well within ± 1% of the scale range when properly installed. The speed of response of the receiver to changes in output air pressure from the transmitter is largely dependent upon distance, the maximum lag being 1 second per 100 feet of connecting tubing.

The system is said to eliminate the hazards of electrical transmission by doing away with electrical circuits in explosive atmospheres. It measures, transmits and receives continuously regardless of electrical current failures.

For the operator out on the unit, it provides an indicating or recording instrument for observation and eliminates the necessity of returning to the main control board to check the performance of the unit.

Bulletin No. 98156 can be obtained by writing to the company.

Agent for Nickel Baths

Linick, Green & Reed, Inc., 29 E. Madison St., Chicago, Ill., have suggested the use of their product, "Ductyl" to overcome brittle deposits from nickel plating solutions. Sodium and ammonium ions, as well as iron in the nickel solution, are known to be causes for embrittlement, and the use of "Ductyl" brings about the precipitation of sodium and ammonium salts without interference with brighteners. Because of the precipitation action, the bath becomes more acidic and, therefore, no acid should be added before additions of "Ductyl" unless

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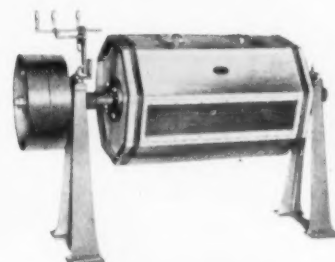


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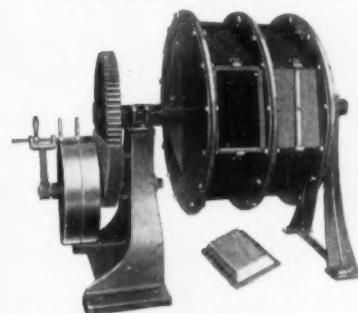


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a lower pH is desired. The material is used in quantity from ¼ oz. per gallon upward.

Iron in solution can be precipitated and removed by filtration by raising the pH of the bath to approximately 6.0 by adding sodium-free nickel hydroxide. After filtering, the bath may be again acidified to preferably pH 5.3 and not higher than 5.5. It is also recommended that no other chemical additions be made to the bath with the exception of nickel sulfate if the bath is low in metal.

The company also manufactures "Tantol" universal brightener and other metal finishing specialties.

Polishing Belt

Industrial Lubricants Co., Inc., Detroit, Mich., makers of polishing wheel cement and polishing wheels, now offer polishing belts

for all types of polishing operations.

The new polishing belts feature an exclusively interwoven-splice, which is said to eliminate all overlapping and to maintain uniform thickness on all points. This results, it is claimed, in smoother, trouble-free performance. In addition, all belts are thoroughly pre-stretched to prevent sagging.

Bogue Electric Co. Expands Line of Motor Generators

Bogue Electric Co., 80 Glover Ave., Paterson, N. J., has expanded its line of motors and generators and has been reorganized to provide efficient service to the industry.

The company reports that it is able to give prompt shipment on all standard units of low voltage, motor generator sets from 500 to 6000 amperes. These motor generator sets are used for anodizing, plating, electrotyping, etc.

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The company was recently awarded a Government contract for approximately \$200,000 worth of equipment, but nevertheless, will be able to give prompt shipment on individual requirements.

The company points with interest to a 3000-ampere unit which was placed in operation in 1904 and has been in continuous service since that time. This unit was recently furnished with its first new set of commutators.

The company can furnish Diesel driven generators where power costs are high or power is unavailable.

Manufacturers' **Literature**

Brazing Alloys. Handy & Harman, 82 Fulton Street, New York City, have issued

a 4-page illustrated folder describing two of their metal joining alloys, namely, "Sil-Fos" and "Easy-Flo". Photographs illustrate uses for these alloys.

Cements. Pennsylvania Salt, Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa., have issued an 8-page folder describing their "Asplit" and "Causplit" cements which are synthetic resin cements, for resisting corrosion and erosion in chemical, paper, steel and allied processes. Working directions for the cements are given and photographs illustrate uses for them. Technical data, such as tensile strength, compressive strength, thermal expansion, etc., are also given.

Chain Belt Conveyor Furnaces. The Electric Furnace Co., Salem, Ohio, have issued a 12-page reprint of an article showing furnace details and containing over 30 illustrations of electric and fuel fired chain

belt furnaces, including radiant tube and special atmosphere installations for the continuous heat treatment of miscellaneous small and medium sized parts and products.

"Filterbestos". Industrial Filter & Pump Mfg. Co., 3017 W. Carroll Ave., Chicago, Ill., describe their processed fibrous filter material called "Filterbestos" for use in filtering operations. The material is used either alone or with filter aids, and is said to form a uniform strong layer of fibre on the filtering surface which gives greater brilliancy to filtrate and saves labor and material costs.

Salt Spray Test Equipment. A folder recently issued by Industrial Filter & Pump Mfg. Co., 3017 W. Carroll Ave., Chicago, Ill., describes salt spray corrosion test equipment built to army, navy and aeronautical specifications. The equipment is rubber lined and features special temperature control.

Surface Hardening of Steel. "Chapmanizing", a process of the Chapman Valve Mfg. Co., Indian Orchard, Mass., is described in a 6-page folder recently issued. "Chapmanizing" service centers are outlined as well as advantages and properties of the process.

New Books

Ingot Brass and Bronze. Issued by Non-Ferrous Ingot Metal Institute, 308 W. Washington St., Chicago, Ill. This publication is in the form of 8½" x 11" pages, filed in a substantial and attractive ring binder. The manual is priced at \$2.00 per copy, delivered within continental U. S. Supplemental material to be issued from time to time will be priced at cost.

This publication is the result of the cooperative efforts of the members of the Metallurgists' Advisory Committee of the Institute. The first edition of the manual contains six sections which deal with such subjects as: nomenclature and classification; physical properties; definition of terms; data on standard alloys, etc.

There are many tabulations of miscellaneous specifications on brass and bronze ingots and castings that are currently in use by various sponsoring bodies. A section of the manual is devoted to a discussion of foundry practice under such sub-heads as melting, deoxidation and fluxing, crucibles, gating, risers, cores, etc. An important section is devoted to foundry defects. It is planned from time to time to issue revised sheets and to publish additional material.

Doing Business Under the Defense Program. Prepared by the Staff of the United States Law Week. Published, November 1940, by The Bureau of National Affairs, Inc., Washington, D. C. Size 8½" x 6"; 123 pages. Price \$1.00; in quantities of 250, 75c.

This book is a handbook of the laws governing business practices during rearmament and gives information which is nowhere else available. Some of the information contained in the book is as follows:

Bidding on defense contracts—the rules on both big and small orders.

Negotiating government contracts—the procedure and terms when departments work directly with a producer rather than throw open to bid.

Securing advances for plant facilities—a convenient way to finance expansion.

Assigning claims to secure loans—a new device to aid in tapping private funds to fulfill orders.

Meeting the special labor requirements set for government contracts.

Planning tax amortization at the new accelerated rates on defense facilities.

Handling sales contracts and other relations with those in military service and those who may enlist or be drafted.

Anodic Oxidation of Aluminum and Its Alloys. By Dr. A. Jenny, translated by Winifred Lewis. 1941. Published by Chemical Publishing Co., Inc., New York City. Size 6" x 9"; 226 pages. Price \$6.50.

This monograph deals with the electrolytic and chemical production of protective surface films on aluminum and its alloys, and with their use in practice. Considerable reference has been made to the production of rectifier valve films, the work on which has appreciably extended our knowledge relative to the production of protective films. Anodic oxidation of aluminum and its alloys, as the title indicates, is the main theme of the book. Technically and commercially the anodic films rank in importance far ahead of the chemically produced protective films. It is the object of the book to present in convenient form a general survey for the technically interested reader, who, in general, has not the time at his disposal to entertain a study of the extensive and scattered literature on the subject, with the object of making him rapidly acquainted with the present day position in the field. For the benefit of readers not specially qualified in electrochemistry, an introductory study of the relevant electrochemical theory, without which understanding of the complex phenomena which occurs is unattainable, has been given.

Directory of Association Members. Sixth Edition. Association of Consulting Chemists & Chemical Engineers, Inc., 50 E. 41st St., New York. This directory may be obtained gratis upon applying to the office of the Association.

This directory describes the organization and services of consultants and consulting laboratories in the chemical field. The book contains statements of each member of the association, describing the officers of the organization, their qualifications and the scope, functions and activities of the organization. Alphabetical and geographical listings of the members are made.

This booklet should enable competent judgment to be made in selection of technical consulting service.

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- AS WHEELS WEAR DIAL CHART SHOWS CORRECT SPEEDS.
- OVERHANGING SPINDLE... MORE WORKING SPACE.
- OPERATOR DOES BETTER WORK... FASTER, EASIER.

Ask for Bulletin No. 30

Bibliography of Spectrochemical Analysis. Compiled by D. M. Smith, A.R.C.S., B.Sc., D.I.C., F.Inst.P. Second edition: 1940; 55 pages. Published by the British Non-Ferrous Metals Research Association, Euston St., London, N.W.1. Price 3s, post free.

In the present second edition of the bibliography, the references have been brought up to August 1940 and now number 510. To conform with current terminology, the title has been changed to "Bibliography of Spectrochemical Analysis." Short explanatory notes are given with most of the references, and an author index is provided. The grouping of the references in sections obviates the necessity for a subject index. There have been some alterations to the arrangement of the matter, possibly the most important of which is the inclusion of a new section on "Applications of the Microphotometer." As before, references are given under the headings of the individual basis metals (with cross-references)

so that the reader may quickly find all the published information dealing with his particular field of interest. The section headings are: Books of Reference; Wavelength Tables; General; Apparatus; Technique; Logarithmic Sector Method; Applications of the Microphotometer; Quantitative Interpretation of Spectra; Analysis of Metals and Alloys (including aluminum, copper, lead, magnesium, nickel, tin, zinc, iron and steel, etc.).

Chemical Engineering Catalog. 1940. Published by Reinhold Publishing Corporation, New York, N. Y. Size 11" x 8"; 1097 pages. It can be purchased at \$3.00 or can be obtained free of charge on a loan basis with the new edition being given free of charge on surrender of the older edition.

This book marks the 25th anniversary of this valuable catalog with the present edition being double that of the first

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Mutual Chemical Co. of America

270 MADISON AVENUE, NEW YORK

edition because of the popular demand. The book is divided into four sections: (1) a trade name index; (2) equipment section with classified index; (3) chemicals and materials section with classified index, and (4) the technical books section.

Catalogs are placed in their proper section and in approximate alphabetical order. In the chemical section, a separate index of laboratory and reagent sections, which was introduced several years ago, has been continued.

The book section has been brought up-to-date and constitutes the most complete bibliography in chemical technology in existence.

The technical data section compiled by prominent men in the chemical engineering field, has been enlarged with the addition of numerous monographs, tables, curves and drawings. Advertising is dispersed, as usual, throughout the book

which, however, is maintained as a standard reference work and not primarily a display advertising medium.

Technical Publications

Protection Against Termites. A handbook for architects and sheet metal workers on the application of sheet copper for termite protection. Second edition, January, 1941. Issued by Copper & Brass Research Association, 420 Lexington Ave., New York.

25th Annual Review of the Silver Market. 1940. Handy & Harman, 82 Fulton St., New York City.

The Deep Drawing, Shearing and Perforating of Monel, Nickel and Inconel. Bulletin T-19. Development and Research Div., The International Nickel Co., Inc., 67 Wall St., New York.

Associations and Societies

American Electroplaters' Society

*Plan to Attend Boston A.E.S.
Convention, June 9th-12th*

Chicago Branch

A most successful annual meeting was held Saturday, January 25th, with several hundred attending the educational session and with over 900 attendants at the dinner and dance in the evening. At the educational session were featured the following speakers:

Joseph B. Niles, Research and Development Engineer, Thomas J. Dee Co., Chicago, Ill. "Industrial Applications for Gold."

Frank K. Savage, Research Chemical Engineer, C. G. Conn., Ltd., Elkhart, Ind. "A Development in Full Automatic Silver Plating."

R. J. Hazucha, The Clinton Co., Chicago, Ill. "The Value of Lacquer Thickness."

G. J. Berry, Electric Products Co., Cleveland, Ohio. "Generators and Rectifiers."

Detroit Branch

On February 7th, Messrs. *E. A. Anderson* of the N. J. Zinc Co., Palmerton, Pa., and *M. R. Caldwell* of W. B. Jarvis Co., will discuss "Electroplating of Zinc Base Die Castings."

The March 7th speaker will be *R. M. Wagner*, Guide Lamp Division, General Motors Corporation.

Los Angeles Branch

Annual Educational Session

The annual all-day Educational Session of the branch will be held at the Los Angeles Breakfast Club on Saturday, March 22nd.

The 1941 session will be held a week earlier than last year and in a different location, last year's meeting having taken place at the Hollywood Roosevelt Hotel on March 30th.

The arrangements committee, headed by Chairman *Marcus Rynkofs*, inspected the facilities at the Breakfast Club on the night of January 13th, pronounced them satisfactory for conference and exhibition purposes, and later in the evening assembled at the home of *Clarence E. Thornton* in Van Nuys to officially name the club as the scene of this year's session.

Preliminary arrangements of the proposed speakers' program and the products exposition were discussed but no definite commitments on the identity of the speakers or the details of the exhibits had reached the stage for public announcement, according to *Ernest Lamoureux*.

Present at the meeting were *Marcus D. Rynkofs*, chairman of the arrangements committee; *Don Bedwell*, ex-officio chairman by virtue of his presidency of the chapter; *Ernest Lamoureux*, *Clarence Thornton*, *Carroll C. McLaren*, *Bruno H. Schindler*, *Em-*

mette R. Holman, Ervin Frauenhoff. Other members of the committee are Earl Coffin and D. N. Eldred.

Newark Branch

On February 21st, the speaker will be G. B. Hogaboom, engineer of Hanson-Van Winkle-Munning Co., Matawan, N. J., whose subject will be "Some Observations on the Throwing Power of Nickel Solutions."

The March 7th speaker will be Nathan Promisel, consultant, Medford, Mass., who will discuss "Silver Plating Practice."

New York Branch

The Proctor Diamond Jubilee Founder's Day

In honor of the 75th birthday of Charles H. Proctor, founder of the A.E.S. and distinguished member of New York branch.

Place: Hotel Pennsylvania, 7th Ave. & 33rd St., New York.

Time: Saturday, February 22, 1941 (Washington's Birthday) Educational Session, 2:30 P.M.; Banquet, 7:30 P.M.; Floor Show, 9:30 P.M.; Dancing, 10:30 P.M.

Technical Session: Edwin C. Rinker, New York Branch Librarian, presiding.

1. Harold M. Lang, Sigmund Cohn, Inc., New York.
Subject: "Electrolytic Polishing".
2. Martin M. Maher, Jr., Etched Products Corp., L. I. City, N. Y.
Subject: "Finishing Zinc Base Die Castings".
3. Dr. Louis Weisberg, Weisberg Laboratories, New York.
Subject: "Bright Copper Plating".
4. Ellsworth Candee, American Brass Co., Waterbury, Conn.
Subject: "Fabrication of Copper & Copper Alloys" and motion picture "From Mine to Consumer".

A week-end holiday celebration for those of the electroplating and metal finishing profession and their ladies.

Subscription: \$4.00 per person.

Franklyn J. MacStoker, General Chairman, 25 Princeton St., Garden City, N. Y.

American Society for Testing Materials

Spring Meeting March 4th and 5th, Washington, D. C.

Two symposia will be held at this meeting; one on "Color—Its Specification and Use in Evaluating the Appearance of Materials," and the other on "New Methods for Particle Size Determinations in the Subsieve Range."

Headquarters, Hotel Mayflower, Washington, D. C.

Electrochemical Society

79th Meeting of the Society, April 16-19, Cleveland, Ohio. Headquarters, Hotel Cleveland.

METAL FINISHING, February, 1941

Modernize Your Pickling Processes With **ENTHONE ACID ADDITION AGENT**

Enthone Acid Addition Agent is a unique surface tension depressant used in hot or cold sulfuric or muriatic acid pickles. Extensive laboratory tests and many industrial users have shown that with the use of ENTHONE AAA the following results are obtained:

- ★ **FASTER PICKLING**—the acid rapidly penetrates under rust and scale, thus lifting them off!
- ★ **LESSENS FUMES**—the attack of acid on bare steel is reduced at least 75%! Less gas to cause harmful fumes!
- ★ **SAVES ACID**—Drag-out is materially reduced and acid is saved by inhibiting action!
- ★ **OVERCOMES WATER-BREAK IN PICKLING**—Due to poor alkaline cleaning or soap in the alkaline cleaner, water-breaks appear on acid dipping before plating. The use of ENTHONE AAA in the acid literally makes the acid a cleaner and overcomes peeling due to faulty cleaning.
- ★ **FASTER STRIPPING OF HEAVY CHROMIUM**—The use of ENTHONE AAA in muriatic acid greatly increases the stripping action on faulty hard chromium and eliminates attack on steel die.
- ★ **FOR STRIPPING ZINC OR CADMIUM FROM PLATING CYLINDERS**—ENTHONE AAA used in acid for stripping zinc or cadmium from plating cylinders will speed the stripping. The acid will penetrate every recess to remove metal causing disintegration of the cylinder. Attack on steel tie-rods is eliminated.

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Chemical Products



Obituaries

L. Joe Nook

L. Joe Nook, well known as proprietor of the Kalamazoo Plating Works, Kalamazoo, Mich., died in January, after being stricken while attending mass.

He was born Lawrence Joe Nook in Kalamazoo, August 10, 1890. He became the principal support of his family at the age of 13, when his father died. He acquired the Kalamazoo division of the Wigginton Co. in 1932 and had operated it as the plating works since then. Mr. Nook was a lifelong member of St. Augustine Catholic Parish, an active member of the Knights of Columbus, Elks, Catholic Athletic Association and the American Electroplaters' Society.

His sudden death came at a time when

he was in the midst of the construction of a new home and he had just celebrated his silver wedding anniversary with his wife, the former Sophia Hook.

He is survived by his widow, three children, a sister and five brothers.

Harry R. MacFadyen

The electroplating industry was grieved to learn of the death of Harry R. MacFadyen, who died suddenly at his home, 9 Forest St., Hartford, Conn., Tuesday evening, January 7, 1941.

Mr. MacFadyen had a long career in the electroplating business. He was born in Brooklyn, N. Y., September 22, 1877, and in 1889 at the age of 12, he went to work in the plating room of Wm. Rogers Mfg. Co., Hartford, Conn. He worked on silver plating until 1905, when he took charge of the plating room of the Hart Mfg. Co. in Unionville, Conn., remaining there about a year. He next went to Bridgeport to take

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CENTRIFUGAL DRYERS
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Carbonate, pH
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charge of the plating room of Harvey-Hubbel Co., and on Sept. 15, 1907 took charge of plating at the Arrow Electric Co., Hartford, which is now the Arrow-Hart and Hegeman Co.

He was an active member of the Hartford Branch of the American Electroplaters' Society, but poor health during the last few years curtailed his activities.

He is survived by his wife, three daughters and a son. The funeral was held at the Memorial Baptist Church, Hartford, and was attended by many members of the electroplating industry.

Alvin Findley

Alvin E. Findley, editor emeritus of The Iron Age, died on December 12th at his winter home in Florida. He was 81 years old.

Mr. Findley was born in Monmouth, Ill., and studied at Buchtel College, Akron, Ohio. He also received an A.B. degree from Worcester College in 1881, and an M.A. degree in 1886. He held numerous editorial positions before joining The Iron Age in 1905 and he became editor-in-chief in 1910, remaining in that post until he retired in 1930. He was editor emeritus thereafter and was a director of the Iron Age Publishing Company.

He was a member and officer of several technical societies.

Warren L. Neu

Warren L. Neu, a former official and director of the Hanson-Van Winkle-Munning Company, Matawan, N. J., died at his home on Friday, January 10th, after a long illness.

Warren L. Neu first entered the employ of A. P. Munning & Company in 1919, as a member of their sales department, later becoming Assistant Sales Manager. After the merger of this company with the Hanson & Van Winkle Company, he was engaged in special sales department work, and in 1930 was appointed Assistant Sales Manager of the Hanson-Van Winkle-Munning Company. During a part of 1932 and 1933 he was located in Anderson, Ind., working with that branch, and then returned to the home office in Matawan, N. J. On March 3rd, 1931 he was elected a director and on March 6th, 1934 a vice-president of the Company, continuing in that capacity until March, 1939.

Mr. Neu was taken ill in February 1937 and was forced by poor health to relinquish his duties as a Director in July 1938. He continued to maintain a deep interest in the welfare of the Company, however, and was always available for his valuable advice and counsel.

Mr. Neu leaves a widow, Mrs. Amy Baier Neu. His loss is deeply felt by a host of friends in the Company and throughout the metal finishing industry in which he was always a helpful factor.

Personals

M. R. Thompson Joins Bureau of Mines

M. R. Thompson who has been connected for twenty years with the section on electrodeposition at the National Bureau of Standards, has accepted a position with the U. S. Bureau of Mines. He will be located in their electrochemical laboratory at Norris, Tenn.; in charge of investigations on the purification of clays and other minerals by electrophoresis (which in some respects is analogous to rubber deposition).

After graduation from the Massachusetts Institute of Technology, Mr. Thompson was engaged in researches on copper refining in South America and in Baltimore.



M. R. Thompson

The principal subjects of his numerous researches at the Bureau of Standards were nickel plating and cyanide solutions. His paper in 1922 upon the acidity of nickel baths was one of the first in which pH measurements were applied to the plating industry. The use of the high-sulphate nickel bath for plating on zinc is based largely upon his experiments. His work on cyanide baths includes methods of analysis and pH measurements, and also a general summary of the constitution of such baths, which will be presented at the Cleveland meeting of the Electrochemical Society in April, 1941. In connection with his pH studies he developed a new type of glass electrode.

Kirke R. Wilson, 10 Lock St., Buffalo, N. Y., manufacturer of automobile repair equipment and tools, with plant at Arcade, N. Y., has acquired Rumsey Pump Corp., Seneca Falls, N. Y., pumping machinery and parts, and will operate as K. R. Wilson Rumsey Pump Co. Production will be continued at Seneca Falls plant, where expansion will be carried out for the manufacture of products produced at Arcade works. The latter plant is being used largely for shell manufacture.



Even in normal times metal finishing departments must operate on schedule . . . must avoid bottle necks. With new metals, new processes and new finishes entering the picture all the time, tough problems of metal cleaning are the order of the day.

Now, when all the emphasis is

on speed, bottle necks are serious. You can help to prevent trouble in your department by keeping in touch with your Wyandotte Service Representative. He is constantly on call for all kinds of metal cleaning help. A word to him today may prevent a bottle neck tomorrow. There is no obligation for his services.



Service Representatives in 88 Cities

THE J. B. FORD SALES CO.
WYANDOTTE, MICHIGAN

H. N. Middleton of the B. F. Sturtevant Company, Camden Branch, has been relieved of sales duties and has been appointed Engineering Consultant for the Eastern Division of this country. He will serve customers and branch offices of the Sturtevant Eastern Division territory in an advisory capacity on dust and fume control and pneumatic conveying problems.

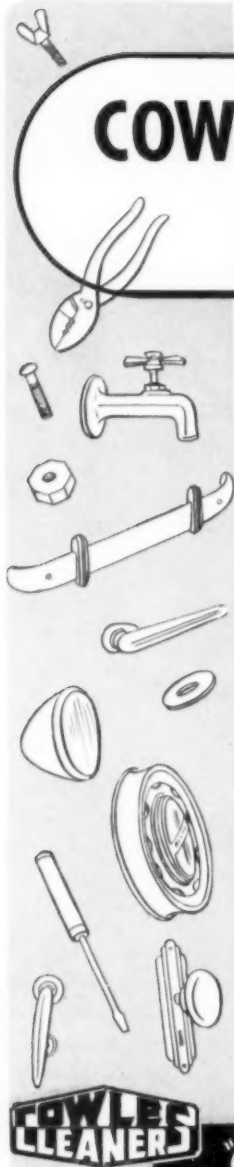
Mr. Middleton has been associated with the B. F. Sturtevant Company for many years. His experience of over 50 years dates back to the pioneering period of the dust and

fume control and pneumatic conveying industries and today he is one of the country's best informed and most experienced men in these highly specialized fields.

O. B. Moe, sales engineer of G. S. Blakeslee & Co., Cicero, Ill., manufacturers of degreasing and cleaning apparatus, has established headquarters in Los Angeles, and will devote his efforts chiefly to promoting the line in the industrial field. Mr. Moe is a member of the Milwaukee Branch of the A.E.S.

COWLES RS CLEANER

AN OUTSTANDING CLEANER IN
THE ELECTROPLATING INDUSTRY



● COWLES RS CLEANER is a general duty cleaner, containing emulsifying and wetting out agents. It is very efficient and economical for use in the electroplating industry. RS Cleaner can be used with equally good results in still tank or electro-cleaning, with direct or reverse current.

RS Cleaner is especially recommended for both steel and brass. It is technically anhydrous and produces chemically clean surfaces with low concentrations, resulting in lower production costs.

Write immediately for more detailed information on COWLES RS CLEANER or call in a COWLES service man.

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Eaton-Clark Co., Detroit • James H. Rhodes & Co., Long Island City and Chicago • Mau-Sherwood Supply Co., Cleveland
Apex Soap & Sanitary Corp., McKees Rocks, Pa.

THE COWLES DETERGENT COMPANY
Metal Cleaner Department
7016 EUCLID AVENUE • CLEVELAND, OHIO



"Cleaner Surfaces for Better Finishes"

Business Items

New Hammond Factory Addition

Hammond Machinery Builders, Inc., Kalamazoo, Mich., a sixty-year old firm and

manufacturers of grinding and polishing machinery, have built a new modern addition to their plant which more than doubles the company's space available for manu-



View of Hammond Machinery Builders, Inc.'s plant with new addition

facturing. Part of the addition will house a modern engineering office and demonstration room where the company's machines will be on display. In another division, a new processing room has been set up and equipped with the company's late model polishing and grinding machinery. This machinery will be used for processing prospective customers' samples.

Vega Airplane Co., Burbank, Cal., has let general contract for a one-story addition for assembling. Cost close to \$500,000 with equipment. Award also has been made for a one-story addition to engineering building. Cost about \$100,000 with equipment. The following departments are operated: welding, chromium plating, sand blasting, grinding, buffing, pickling, cleaning, degreasing, anodizing, chromodizing, painting. The principal base metals used are steel, aluminum, and stainless steel.

Metalitor Corp., have announced removal of the company's offices, on January 1st, from 116 Walker Street, New York, to 205 West 19th Street, New York. The corporation specializes in plating of plastics and has a complete installation for doing all types of finishes.

Air Preheater Corp., 60 E. 42nd St., New York, power plant equipment, subsidiary of Superheater Co., same address, has let general contract for a one-story addition to plant at Wellsville, 85 x 225 ft. Cost over \$150,000 with equipment. The following departments are operated: stamping and welding. The principal base metal used is steel.

Hartford Steel Ball Co., 12 Jefferson Ave., W. Hartford, Conn., manufacturers of steel, aluminum and bronze balls, will begin superstructure for one-story addition 82 x 90 ft. Cost close to \$40,000 with equipment.

At a meeting of the Directors of the Cowles Detergent Co., Cleveland, Ohio, the following new officers were elected: E. N. Horr, vice-president and general manager; C. C. Bassett, vice-president and director of sales; C. C. Barrett, secretary and treasurer and C. H. Fisher, assistant secretary and treasurer. These new officers take office immediately. Mr. Horr has been with the company since 1925, most recently in charge of production and purchasing. Mr. Bassett has been with the company since 1931 and has managed the Mitchell Wing division at Cambridge, Mass., since 1932. Mr. Barrett has been secretary of the company since 1927 and Mr. Fisher has been tax specialist and accountant since 1929.

The Falk Corporation, Milwaukee, Wisconsin, manufacturers of gears, couplings, steel castings, and heavy machinery announce the promotion of Harold F. Falk to the position of General Superintendent.

Upon receiving his degree from the School of Engineering at the University of Wisconsin, Mr. Falk became associated with the Falk Corporation and rose to the position of Superintendent of the Welding De-

partment where he remained until 1936.

After devoting his attention to time study and special work in the shop and engineering departments, he was placed in charge of shop production and schedules in 1937, working in that capacity until 1940 when he was appointed Production Manager.

H-V-W-M Company Adds To Staff

The Hanson-Van Winkle-Munning Company, Matawan, N. J. manufacturers of electroplating equipment and supplies have made a number of additions to their staff. The sharp rise in their business has necessitated increased field representation to provide for the continuance of their customary service.

John E. Keyes, who has been transferred from the Company headquarters in Matawan, N. J. has assumed his duties as a representative, located in the Detroit office at 2342 West Grand Blvd. Mr. Keyes brings to the Company a long and varied experience in plating and polishing work in large production plants.

William J. Wise, who was for many years associated with the finishing department of the National Cash Register Company, has joined the Hanson-Van Winkle-Munning sales organization. Mr. Wise has opened a new office located at 601 Oxford Ave., Dayton, Ohio. Mr. Wise is a chemist, a graduate of University of Dayton and has wide experience as an all-around finisher.

Robert M. Norton, formerly Sales Manager of the Western Union Telegraph Co., in New Jersey and Eastern Pennsylvania has been assigned to work with H. A. Todd, representative of the Company in Syracuse, N. Y., after a period of training in Matawan.

J. MacDonald Smith for many years president of Kabushiki Kaisha A. P. Munning Co. of Kobe, Japan, has returned to the United States. He has rejoined the Hanson-Van Winkle-Munning Company as Export Manager with headquarters at their New York office, 30 Church St. Mr. Smith will also have an office at Matawan, N. J.

O. Waring Mellick, sales representative of the Hanson-Van Winkle-Munning Company has been transferred from their main office, Matawan, N. J. to their Bridgeport, Conn.

MAXIMUM BATCHES

...HERE'S THE CRATE TO HANDLE 'EM!

Strong, light-weight, welded Monel construction boosts payload, speeds production



One of 6 pickling crates for hollow ware, built of hot-rolled Monel angles, flats and rounds, all-welded, in plant of Geuder, Paeske & Frey Co., Milwaukee, Wis.

In times like these, it doesn't pay to depend on clumsy, old-fashioned equipment. Instead, you want speed, safety and freedom from breakdowns. Change to modern equipment of welded Monel and see what you accomplish:

1 BOOST PAYLOADS... because modern design utilizing Monel combines strength with light weight for greater capacity.

2 SPEED PRODUCTION... because, in addition to carrying bigger payloads, light-weight Monel equipment is easy to handle.

3 GUARDS AGAINST BREAKDOWNS ...because Monel resists corrosion, retains its toughness and strength.

4 REDUCE MAINTENANCE COSTS... because equipment of Monel withstands abuse, gives long, trouble-free service.

Speed the flow of parts through your Pickling Room by changing to Monel. Write for the booklet, "Equipment Designs for the Pickle House." Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.

"Monel" is a registered trade-mark of The International Nickel Company, Inc., which is applied to a nickel alloy containing approximately two-thirds nickel and one-third copper.



J. MacDonald Smith



Robert M. Norton



Wm. J. Wise

MICCRO PRODUCTS

Have Been Scientifically Developed for EASY APPLICATION



Extreme left:—Hand dipping of plating racks in drum of Microlite.

Left:—After application, racks will air-dry quickly. Force drying with heat is also employed.

There are no "tricks" in the application of any "Micro" product. Any employee in your plant who is of average intelligence can handle the work and apply most effective protective coatings.

In applying MICCRO-SUPREME STOP-OFF LACQUERS or MICCROLITE for coating plating racks, the dipping process is recommended. In these operations, it is only necessary that dipping speeds be maintained . . . that the necessary number of coats be applied . . . and that sufficient drying time be allowed. Air drying of both materials is extremely fast, and it is now possible to also force-dry the materials at 125° to 150° Fahrenheit providing further reduction in drying time. No preparatory work other than cleaning the surface to be coated is required.

MICCROLAC is the new water-white, non-blushing protective coating used to protect and beautify natural metal or plated surfaces. It has proved to have excellent adhesion to cadmium, chrome or other greasy type surfaces, and is an effective primer for colored lacquers and bronzing liquids. It is particularly adaptable as a protective coating for silver plated, polished brass or brass plated products and is used on copper, aluminum, wrought iron, stainless steel, etc. Unlike other lacquers of its type, it comes ready for use, eliminating time and guesswork in adding thinner and assuring proper application.

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MICHIGAN CHROME & CHEMICAL CO.
6348 EAST JEFFERSON DETROIT, MICHIGAN

office at 5th & Charlotte Sts. Mr. Mellick is a graduate of Yale University, Sheffield Scientific School and before engaging in the plating equipment and supply field was connected with Post & Flag, New York City.

John Vander Voort has been transferred from the duties of a direct sales representative in upstate New York to special duties in the main office of the Company at Matawan, N. J.

MacDermid, Inc. Hold Sales Conference

MacDermid, Inc., Waterbury, Conn., held their annual sales meeting at the Hotel Elton, Waterbury, January 9-11. In attendance were fifteen sales and service representatives from Chicago, Detroit, Cleveland, Rochester, Pennsylvania, New Jersey and the New England states, and papers were presented on past experiences and the numerous applications under consideration with

newer developments. Executives were also present from firms which manufacture equipment that is distributed in New England by MacDermid, Inc.

R. I. Thompson, previously in charge of the Detroit office of Ampco Metal, Inc., Milwaukee, Wis., has been promoted to manager of the Eastern district, overseeing field engineering offices at Boston, Springfield, Mass., New York, Philadelphia and Washington. Mr. Thompson will make his headquarters at 2 Colton Rd., Hartford, Conn. S. C. Lawson is to take care of the Central district which comprises the Chicago, St. Louis, Indianapolis, Cincinnati and Michigan territories. He will be located at 600 S. Michigan Ave., Chicago.

R. H. Hathaway, formerly sales engineer for Production Machinery Company, Greenfield, Massachusetts, has been appointed assistant to Chief Engineer Henry J. Kings-

bury, Hammond Machinery Builders, Inc., Kalamazoo, Michigan, it was announced recently by W. C. Hammond, pres.

Mr. Hathaway was educated at Technical High School, Fall River, Massachusetts, and Tufts Engineering College, gaining his technical experience largely in the polishing and abrasive equipment field.



R. H. Hathaway

His appointment as Assistant Chief Engineer for the Kalamazoo concern comes as part of their current expansion of manufacturing space and personnel made necessary by increased business.

James W. Hughes recently was appointed representative in the Wisconsin territory for Frederic B. Stevens, Inc., Detroit, succeeding his uncle the late Jim Hughes. James W. Hughes attended George Washington University and then was engaged in newspaper and magazine work in editorial and advertising capacities until 1933 when he went to Washington to serve in the congressional office of his uncle. Later he worked as secretary for United States Senator Duffy of Wisconsin, and three years later left Washington to engage in sales work in the Detroit area for the Armstrong Cork Co. He became connected with Frederic B. Stevens, Inc., in September 1940.

Waterbury Lock & Specialty Co., Milford, Conn., plans a one-story addition, about 45 x 160 ft., and improvements in the present plant. Cost over \$25,000. The following departments are operated: stamping, soft soldering, plating, polishing, buffing, barrel burnishing, tumbling, cleaning (alkaline), degreasing (solvent), and lacquering. The principal base metals used are: steel, brass, bronze and zinc.

Magnus Chemical Co., Inc., Garwood, N. J., manufacturers of cleaning materials, industrial soaps, metallic soaps, emulsifying agents and metal working lubricants, announce four appointments as follows:

Paul Blanchard, sales representative in Scranton, Pa., and vicinity; Henry W. Scott, resident sales representative in southeastern Florida; Walter E. Winship, representative of Magnus in the State of Louisiana and southeastern Mississippi, and J. H. Welch, sales representative in Arkansas and the western part of Tennessee.

Cannon Electrical Mfg. Co. Holds Open House

Climaxing its 25th anniversary, Cannon Electrical Co. held open house to mark the formal opening of its new specialty factory and electroplating plant at 3200 Artesia St., Los Angeles, on December 22.

Approximately 1,500 visitors toured the plant, with President James H. Cannon, Vice-president Robert C. Cannon, and Superintendent Ray Cromwell playing the roles of hosts.

The night after the formal opening, open house was held for employees and their families, which was highlighted by the presentation of bonus checks to each of the 400 employees.

The new plant represents an investment of \$100,000. The firm was started with two employees in 1915 by James H. Cannon. It is now devoted almost exclusively to the manufacture of electrical cable connectors for aircraft, "sound" and allied industries. The line of products comprises a great variety of fittings for which the firm has world-wide distribution.

The new factory employs 400 persons and has departments and equipment for pattern making, sand casting of brass and aluminum, die-casting of aluminum, brass, magnesium and zinc, heat treating, electroplating, spray painting and sand blasting, a complete tool and die making department and machine tool equipment.

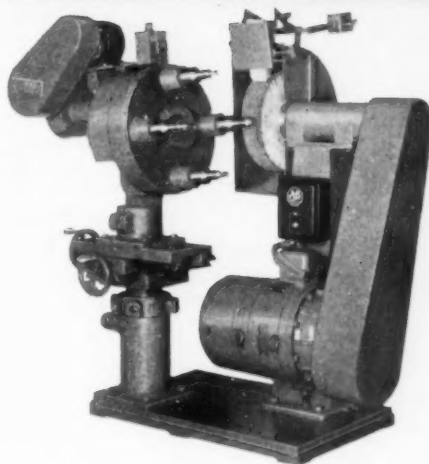
The electroplating department, which has been presided over by Carroll C. McLaren for the past 1½ years, is designed to the most modern conceptions of plating shop technique.

Aro Equipment Corp., Bryan, Ohio, lubricating equipment and devices, plans a one-story addition, 105 x 190 ft. Cost over \$100,000 with equipment. The following departments are operated: brazing, welding, plating, grinding, polishing, buffing, barrel-burnishing, descaling, pickling, degreasing (solvent), enameling. The principal base metals used are: steel, brass, aluminum and zinc.

A. C. Harvey Co., Allston, Mass., who have been identified for years with the sale of steel products and welding equipment in New England, have been appointed jobbers of the line of arc welders built by Hobart Brothers Co., Troy, Ohio, and will collaborate with Leo Gordon of the New England distributing office.

A. W. Cash Valve Mfg. Co., N. Water St., Decatur, Ill., valves and kindred engineering specialties, will take bids at once on general contract for one and two-story addition, 105 x 160 ft. Cost close to \$100,000 with equipment. The firm operates the following departments: stamping, soft soldering and

Another "Acme" Combination Unit for Polishing and Buffing!



ACME
SEMI-AUTOMATIC
AND LATHE
COMBINATION
UNIT

**SEND
SAMPLE
for
FREE
Production
Estimate**

It is easy to understand how Acme Automatics speed up production when you stop to consider that the 4-spindle machine illustrated above, for polishing and buffing cylindrical parts, has an indexing range up to 800 indexings per hour, and a still greater speed when equipped with an 8-spindle head.

To meet the demands of present-day production, not only as to speed but also as to low production costs, Acmes are built in a great variety of machine arrangements of universal application, each so designed as to perform its particular job most efficiently. If you have a polishing or buffing problem, we shall be glad to submit suggestions as to how it can be solved.

ACME Manufacturing Co.
1642 HOWARD ST. • DETROIT, MICH.
Builders of AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS

grinding. The principal base metals used are brass and bronze.

Sheffield Gage Corp., 1517 E. Third St., Dayton, Ohio, plans additional construction which will cost close to \$1,000,000 with equipment.

Allied Industrial Products Co., 17 N. Elizabeth St., Chicago, Ill., effective January 18, 1941, have announced the removal of their general offices and purchasing department to 620 North Michigan Ave., Chicago. The move was made to acquire additional manufacturing facilities to meet the new demands of business made on the company. The company employs 200 people and has been in business eighteen years. The officers of the company are J. J. Lawler and C. J. Cahill. Allied Industrial Products Company offer a complete line of buffing and polishing wheels, abrasives, oil removers, drawing compounds, etc., to the trade.

Charles Hardy, Inc., Hardy Metallurgical Co., announce the removal of their executive offices from 415 Lexington Avenue to Graybar Building, 420 Lexington Ave., New York City.

Ideal Commutator Dresser Co., Sycamore, Ill., motor maintenance equipment, electrical specialties, etc., has let contract for a one-story addition, 94 x 145 ft. Cost over \$60,000 with equipment.

The United States Stoneware Co., Akron, Ohio, manufacturers of corrosion-proof chemical equipment, has just acquired the Federal Clay Products Co., Mineral City, Ohio, along with their extensive clay and coal deposits. The newly-acquired company has been incorporated as the Federal Refractories Corp., to continue their old and well-known line of fire-brick, refractories, high temperature cements, etc. The Federal plant will be expanded to handle the rapidly in-

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creasing business of the company on tower packing rings, spiral rings, acid-proof brick, lining tile, etc. The Tallmadge (Ohio) plant will be enabled to realign their production facilities to care for their present large volume of business on acid-proof piping, tank linings, process equipment, acid-proof tanks, pumps, etc. New equipment is being installed with that purpose in view.

Patent Digest

Rust Prevention

U. S. Patent No. 2,224,695. C. F. Prutton, December 10, 1940. A corrosion inhibitor for metals comprising an ester of an acid of phosphorous miscible in oil and which will react in contact with water to yield a solution having a pH below 7 and an oil vehicle therefor. At least one of the hydrogen atoms in the acid is to be replaced by an

ester group and at least one by an inorganic radical. For example:

Mix approximately 5% of diphenyl phosphoric acid and 95% of a refined mineral oil (about 180 S. U. S. at 100°F.) which is heated to about 180°C. Sheet steel is dipped in the hot mixture which reacts with the surface to form an adherent film of organic iron phosphate.

Rust Removal

U. S. Patent No. 2,220,451. J. K. Hunt, assignor to E. I. duPont de Nemours & Co., November 5, 1940. A process for removal of rust comprising pickling in a water soluble compound of sulfamic acid, the solution being acid to litmus.

Example: Five percent by weight of sulfamic acid at 180°F.

Solder for Thin Surfaces

U. S. Patent No. 2,220,961. E. W. Kern, assignor to Bell Telephone Laboratories, Inc.,

November 12, 1940. A soldering composition for use on gold, silver or platinum composed of 54% to 48% lead, 43%-39% tin and 3%-13% of a metal corresponding to the surface to which the solder is to be applied. The lead solder is saturated with the metal so that there will be no diffusion of metal from the thin sheet into the lead during soldering.

Electrolytic Screen

U. S. Patent No. 2,221,502. W. van de Pol (Netherlands), November 12, 1940. A process of oxidizing selected areas of an aluminum or other metal matrix to provide portions composed of a firmly adherent metal oxide corresponding to the perforations of the finished sieve, incorporating a non-metallic insulating substance in said portions of metal oxide, thereby rendering said areas resistant to electrodeposition, electrodepositing a sheet of metal on said matrix and finally detaching the deposited metal from said matrix.

Multiple Deposits

U. S. Patent No. 2,221,502. C. J. Wernlund, assignor to E. I. duPont de Nemours & Co., November 12, 1940. An article and method comprising the use of a white brass plate as an undercoat for nickel deposits, especially bright nickel, on zinc base die-castings. The deposit should be at least 0.0001 inch thick and should contain 19-31% by weight of copper. It is claimed that the deposit will not diffuse into the base metal.

Coloring Nickel

U. S. Patent No. 2,221,641. B. B. Knapp, assignor to The International Nickel Co., Inc., November 12, 1940. The production of black coatings on nickel and nickel plate by subjecting to the action of a bath having a pH of about 1 to 2 containing an oxidizing agent having at unit activity an oxidation-reduction potential more negative than about -1.75 volts and a reducible sulfur compound selected from the group consisting of thiocyanate, sulfite, and thiosulfate in effective amounts for a period of time at a temperature of about 15°C. or higher.

Example:

Ammonium persulfate 200 g./l. approx.
Ammonium thiocyanate 5 "

Immerse at above 15°C. for not more than 5 minutes.

Example:

Ammonium persulfate 50-200 g./l.
Sodium sulfate 25-100 "
Ferric sulfate 1-10 "

Ammonium thiocyanate Enough to give red color to the solution.
Immerse at 15-20°C. for periods up to 5 minutes.

Example:

Potassium thiocyanate 0.5 g./l.
Sulfuric acid 5.0 "
30% Hydrogen peroxide 25 cc./l.
pH = 1.2

Pickling Apparatus

U. S. Patent No. 2,221,811. T. E. Nicklas, November 19, 1940. A method and apparatus for pickling metal in coiled form comprising immersion in the bath, uncoiling and then recoiling while immersed, and at a velocity sufficient to dislodge gaseous particles on the surface.

Acid Cadmium Bath

U. S. Patent No. 2,222,398. H. Brown, assignor, by mesne assignments, to The Udyllite Corp., November 19, 1940. A method of depositing ductile, matte, adherent cadmium from an acid cadmium solution in the presence of an addition agent from the group consisting of naphthol sulfonic acids. A strong bond is obtained, it is claimed, to iron and aluminum.

Example:

Cadmium as sulfate 3-12 oz./gal.
Free sulfuric acid 0.4-13 "
2-Naphthol-6-sulfonic acid 0.25-0.7 "
C.D., 10 amperes/sq. ft. up to the gassing point.

Automatic Plating Machine

U. S. Patent No. 2,222,839. W. F. Hall & G. B. Hogaboom, assignors to Hanson-Van Winkle-Munning Co., November 26, 1940. An automatic plating machine giving an oscillating motion to the racks.

Acid Pickling Inhibitor

U. S. Patent No. 2,223,299. K. G. Chesley, assignor to Crossett Chemical Co., November 26, 1940. The reaction product of wood oils with a substance which has available ammonia and in whose structural formula none of the hydrogen atoms of the ammonia are replaced, at a temperature below the range of thermal decomposition of the product.

Rustproofing Composition

U. S. Patent No. 2,223,458. E. A. Nill, assignor to The H. A. Montgomery Co., December 3, 1940. A solution of a metallic sperm oil soap which is insoluble in water in sperm anilid mixed with mineral oil.

Buffing Head

U. S. Patent No. 2,223,638. E. G. Peterson, December 3, 1940. An inflated conical gas cell buffing head.

Electrolytic Iron

U. S. Patent No. 2,223,928. M. G. Whitfield & V. Sheshunoff, assignors to Reynolds Metal Co., December 3, 1940. A method of making electrodeposited iron which includes circulating within the plating cell an acid solution of ferrous salt, and subjecting a relatively thin layer of said solution between a cathode and a soluble anode to electrolysis while adding from time to time to said solution, ferric iron at least approximately 1% of the total iron content of the solution and maintaining a buffer such as sodium fluoride therein not exceeding in concentration approximately 10 g./l. and holding the pH between 2.8-3.2 approximately at 75-100 amperes/sq. ft. Annealing of the deposits for 30 minutes at 1350°F. renders the deposits ductile.

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FEB. 1—Reports of interest to platers everywhere continue to come from users of United Chromium's "Unichrome" Rack-Coating-W, regarding the remarkable properties of this rack-insulating material. One of these users connected with a prominent plant is especially enthusiastic. He reports . . . "Have had a thousand hours constant use of racks coated with Unichrome" Rack-Coating-W—through cleaners at 180° to 212° F., and cobalt-nickel solution at 155° F., and then through chromium plating solutions." Another user says . . . "After 11 months use your Unichrome" Rack-Coating-W is still standing up fine in both the bright nickel and chromium solutions."

Enthusiastic approval of Unichrome" Rack-Coating-W by platers is attributed to its unique combination of advantages. These are:

1. Withstands boiling cleaners and all plating solutions
2. Tough—withstands wear and tear of handling
3. Contains no ingredients harmful to plating solutions
4. Cuts costs—reduces frequency of re-coatings
5. Easy to apply—"dip and force dry" method

6. Light in color—easy to see how well the rack is covered

7. Any part of rack can be recoated without recoating entire rack.

Write for Bulletin 31

Containing Complete Information—

Platers without rack coating facilities may have their racks coated with "Unichrome" Rack Coating-W by Chromium Corporation of America, 4645 West Chicago Avenue, Chicago, Ill. Belke Manufacturing Company, 947 North Cicero Avenue, Chicago, Ill. or United Chromium, Inc. of Waterbury, Conn.

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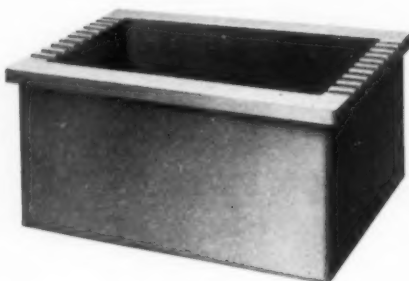
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W. C. BRATE COMPANY
EST. 1860 ALBANY, NEW YORK

Preventing Spray

U. S. Patent No. 2,223,973. R. Teats, assignor to American Smelting and Refining Co., December 3, 1940. Spray is prevented in an electrolytic cell, especially in acid cadmium plating by adding a frothing agent so as to form a layer of stable froth on the surface. The patent claims a baked or roasted cereal mixture of whole wheat flour, bran and cane sugar molasses such as "Instant Postum."

Abrasive Throwing Machine

U. S. Patent No. 2,224,153. J. E. Guendling, assignor to The American Foundry Equipment Co., December 10, 1940. A centrifugal abrasive throwing machine having improved means for controlling the direction of flight of the thrown abrasive.

Buffing Wheel

U. S. Patent No. 2,226,256. C. J. Peterson & A. H. Peterson, December 24, 1940. A buffing wheel with a thin, laminated, flexible buffing cylinder provided with a relatively large central aperture, a lining for said aperture, a stiff apertured centralizing block fitted into said lining and an outer rigid plate member secured to said block to stiffen the central part of said buffing cylinder adjacent the aperture therein.

Vertical Strip Cleaner

U. S. Patent No. 2,224,267. E. A. Matteson & W. R. Meredith, assignors to The Aetna Standard Engineering Co., December 10, 1940. An apparatus for cleaning or polishing metal sheets, strip or the like, especially for removal of oil from tin orterne plated steel strip.

Abrasive

U. S. Patent No. 2,224,711. A. J. Weinig, December 10, 1940. A dry abrasive for fine grinding comprising a dry mixture of powdered silicon carbide, powdered flint and precipitated copper hydroxide, the grain size of the silicon carbide not exceeding 20 microns and the grain size of the flint not exceeding 5 microns in size.

Buffing Wheel Hood

U. S. Patent No. 2,225,225. C. A. McElevey, assignor to The Day Co., December 17, 1940. An improved buffing wheel housing.

Electroformed Screen

U. S. Patent No. 2,225,733. W. Beebe, assignor, by mesne assignments, to The Trumbull Metal Products Co., December 24, 1940. The method of forming fine mesh metal screens which comprises depositing a light-hardenable coating on a member, exposing said coating to light through a screen to form a predetermined pattern of light-hardened material, removing the unexposed portions of light-hardenable material, etching the uncoated areas of said member to form a relief pattern corresponding to said first pattern, molding a matrix constituting a negative of said member, molding from said matrix a rubber printing plate constituting a positive and having a pattern corre-

sponding to said first pattern, employing said plate to print said last pattern in non-conducting material on a plate, electrically depositing metal on the unprinted conductive areas of said plate to form a screen and stripping said screen from said plate.

Electroformed Screen

U. S. Patent No. 2,225,734. W. Beebe, assignor, by mesne assignments, to The Trumbull Metal Products Co., December 24, 1940. The method of forming metal screens which comprises forming on a metal plate a pattern of non-conducting material constituting a negative of the screen, baking the non-conducting material at a temperature from 300°F. to 400°F. to render it adherent to said plate, electrolytically depositing a metal on the non-coated areas of the plate to form a screen, thereafter baking the non-conducting material at a temperature of from 300°F. to 400°F. to render it adherent to the plate and stripping the deposited screen from said plate.

Electroforming

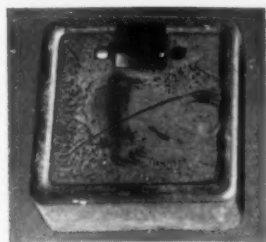
U. S. Patent No. 2,225,794. Keisaburo Ota (Japan), December 24, 1940. A method of manufacturing a curved constructional metal member, which consists of depositing iron of desired thickness on a metal cathode which has been coated with an alloy of lower melting point, for a separating film, and then quickly and bodily introducing the plated matrix into a heated furnace maintained at above 500°C. so as to quickly and uniformly heat said deposited iron and matrix, thereby automatically separating the deposited iron layer from the matrix without producing any crack or break.

Electroformed Screen

U. S. Patent No. 2,226,384. E. O. Norris, assignor to Edward O. Norris, Inc., December 24, 1940. A process of producing a foraminous sheet which comprises producing by electrolytic deposition a foraminous sheet structure, reducing the thickness of the sheet and enlarging the holes by removing by an etching process a stratum of material from the same of a depth sufficient to leave a skeleton screen presenting a smooth surface throughout, substantially free from irregularities of contour, and then adding to the skeleton screen by electrolytic deposition a stratum of material of a thickness sufficient to build the structure to a predetermined land cross-section area, the area of the added stratum of material at any cross-section of land being greater than that of the skeleton screen at the same section of land.

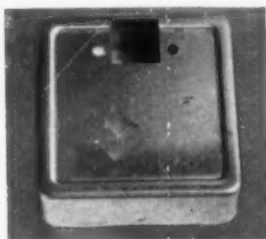
Electroformed Screen

U. S. Patent No. 2,226,382. E. O. Norris, assignor to Edward O. Norris, Inc., December 24, 1940. A matrix for the production of electroformed foraminous sheet comprising a base plate presenting a surface adapted to receive an electrolytic deposit and a plurality of protuberances of readily deformable resilient electrolytically passive material projecting from said base plate and mechanically interlocked therewith by means of a flange embedded in said base plate.



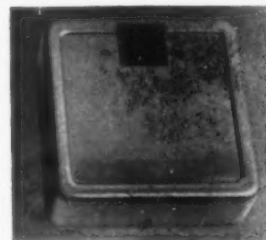
BEFORE CLEANING

Instrument case drawn with lubricant containing lithopone — hard to remove without hand scrubbing.



AFTER FIRST STAGE

Same piece after first stage dip and pressure spray rinse. Note clean appearance except for water break.



AFTER SECOND STAGE

Same steel piece after electrocleaning with Magnus Metal Cleaner No. 94XX. Note completely clean condition and absence of water break.



Whenever polishing compounds, pigments, chlorinated and sulphurized oils, smut and the like have to be removed from any metal before finishing operations, trouble or expense has always been experienced because existing cleaning methods did not quite meet the situation. Almost always hand brushing or scrubbing was necessary before the final tank or electrocleaning operation put the metal in condition for plating.

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(Patent applied for)

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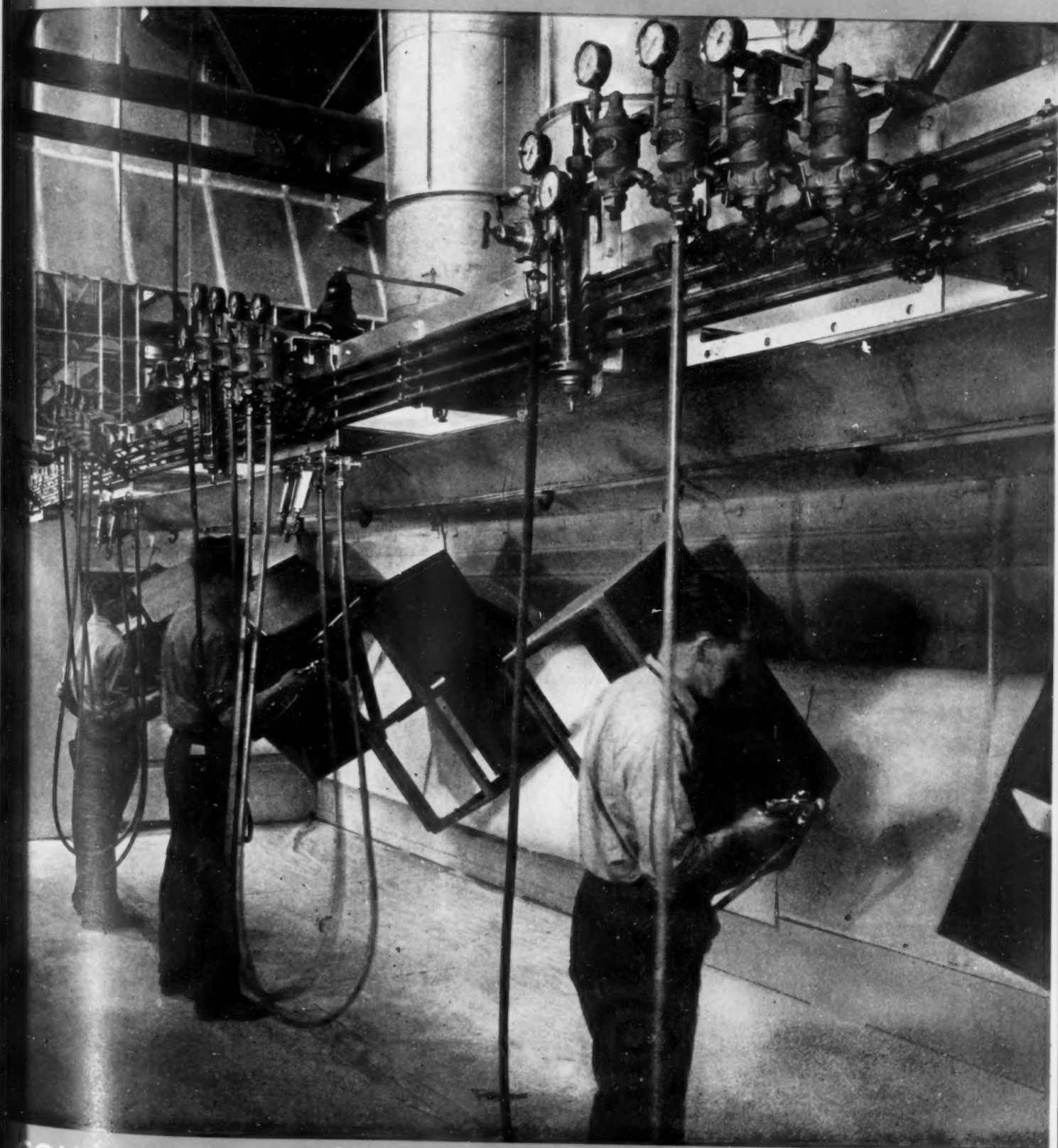
WATERBURY ROLLING MILLS, Inc.

Waterbury, Conn.

FEBRUARY, 1941

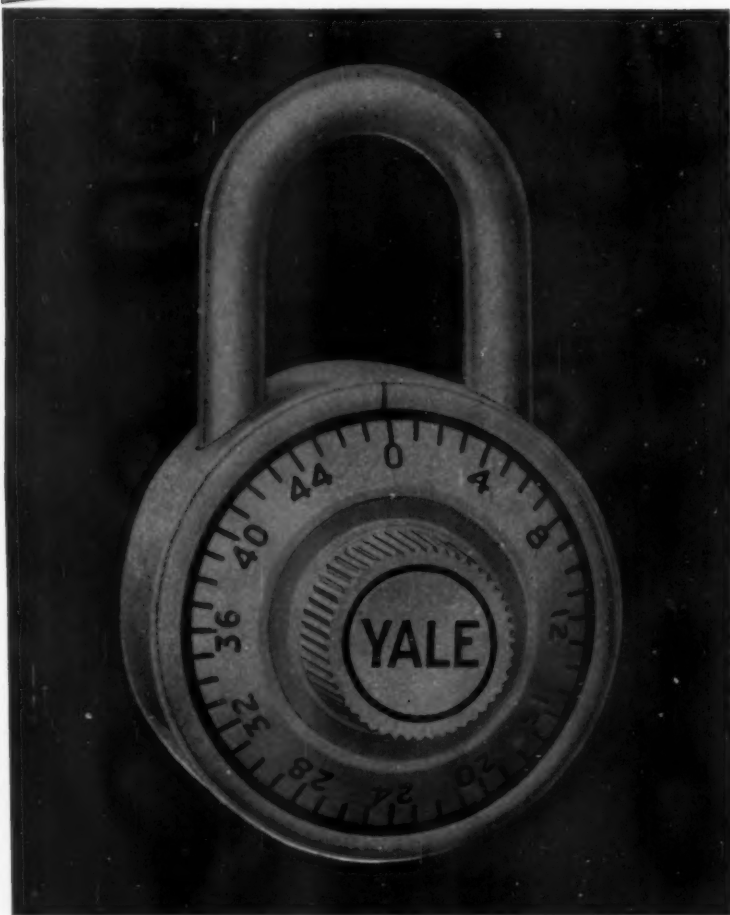
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FEBRUARY, 1941

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Heat Resisting Finishes

In the last few years there has been a demand for finishes which will retain their protective and, more important, their decorative properties under long heating—the object being, of course, to open up fields held by vitreous enamel, etc. As a matter of fact, many users of finishing materials would have been satisfied if heat resistance had been developed only to the point where discoloration and loss of film strength might not be expected if for any reason their materials happened to be over-baked.

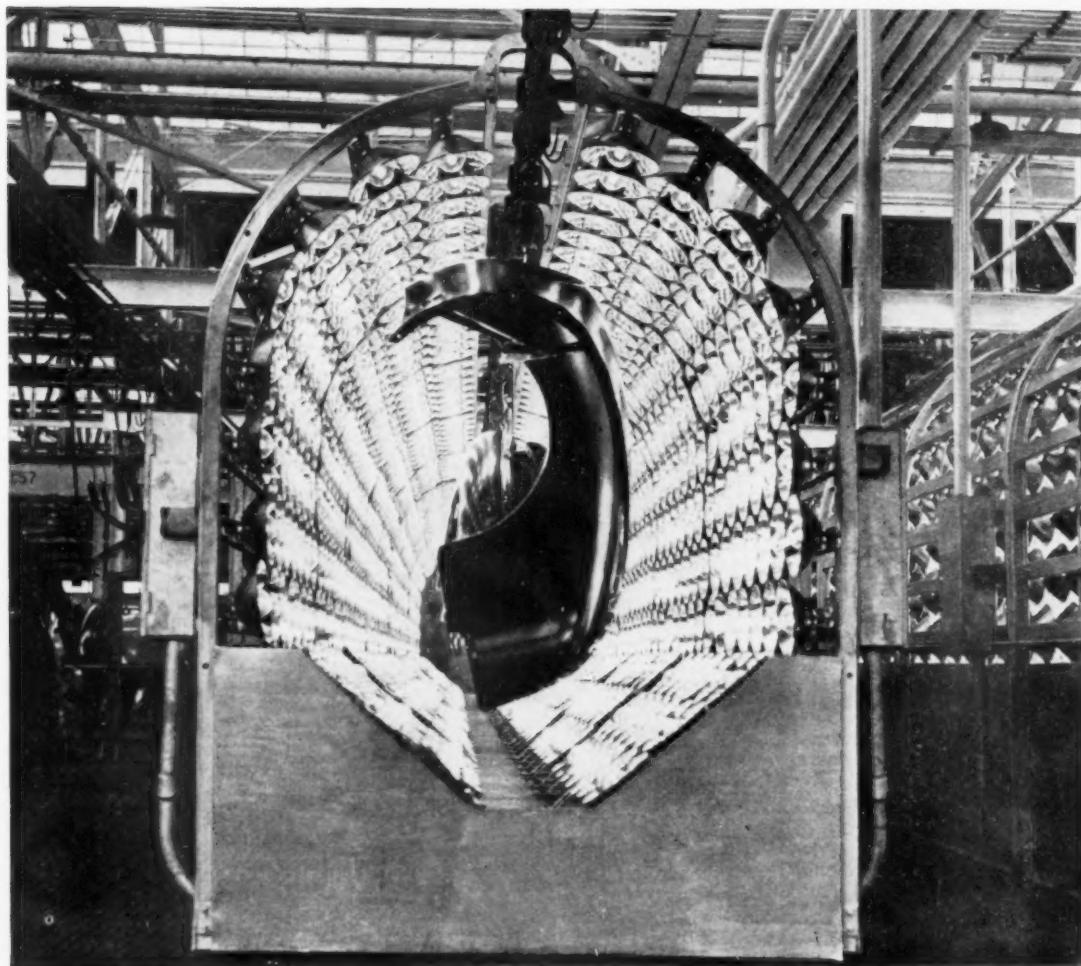
At first glance it would seem that the demand for heat resisting finishes might never be fulfilled. As the term implies, organic finishes are based on organic compounds—the vehicles—and organic compounds do not in general resist high temperatures for any long period.

In spite of this, the manufacturers of organic finishing materials have not been deterred and as a result we have organic finishes in a wide variety of colors being used today on kitchen ranges, oil burners, and other domestic and commercial equipment where finishes must resist heat.

This development has been truly remarkable and we believe that the end is not yet in sight. We predict that organic finishes will be formulated to withstand still higher temperatures and thus broaden the already wide scope of organic finishing.

Infra-red in Industry*

By JOHN SASSO



Fender finish is quickly dried by passing the parts through a lamp-lined tunnel.

RADIANT energy, produced by short wave lengths in the infra-red range of the spectrum, was applied a few years ago by the Ford Motor Company to the drying of automobile body finishes. Since then electrical infra-red drying has attained considerable acceptance; it is now being used for drying prime and finishing coats on auto bodies, enamel on parts such as steering columns, lacquered surfaces, paint on castings, enamels on die-castings, for softening plastic sheets prior to punching and for baking transformers and armatures.

Advantage has been taken of radi-

ant heat in conventional gas-fired baking ovens for years. However, in the last few years, new electric and gas infra-red heat sources have been developed. Widespread attention has been given electrical sources of this energy because of the high color temperature and efficiencies obtained with incandescent lamps, and because the baking set-up is simple, even though it is sometimes difficult to place the full surface of the part being dried in front of the rays. In complicated assemblies, having shadows and inaccessible surfaces, convection oven baking is usually the

solution. But some finishes cannot be successfully dried by convection, and conduction must be used.

In non-technical terms infra-red energy is similar to what we know as light, except that infra-red is longer in wave-length than visible energy. The fundamental principles parallel those of lighting. However, sources of radiant energy operate at a lower temperature than those used for light.

Another difference lies in the amount of energy required; in radiant heating, densities on a surface may

*Reprinted from American Machinist, Oct. 1940

run as high as 1,000 watts per sq. ft.; the same surface would be brilliantly illuminated with 50 watts per sq. ft. In the radiant spectrum, wave-lengths are in that portion overlapping light wave lengths and extend from 0.6 to 0.7 millionths of a meter to five millionths of a meter. Commercial sources of radiant energy emitting most of their energy in the wave-length of one-millionth of a meter operate at 2,500 F. By lowering the temperature of the source, the wave-length is increased.

Incandescent bulbs arranged in various ways, Fig. 1, furnish the source of energy for infra-red drying. Both tungsten and carbon filament lamps are used. Originally the standard lamp was 240-260 watts; recently tungsten lamps of higher capacity, 500 and 1,000 watts, have been announced for this process. See Table I. Maximum energy distribution of these lamps occurs at about 2,500 deg. absolute, with wavelengths of about 11,000 to 14,000 angstrom units (0.0000011 to 0.0000014 meters long) depending on the type.

Of the electrical energy input into these lamps, approximately 90 per cent is converted into heat waves which penetrate the surface and are reconverted into heat energy. The re-

TABLE I—AVERAGE WATT PER SQ. IN. ON WORK

	Triangular banking of units*	Rectangular banking of units*
250-watt drying lamps in 12 in. gold-plated reflectors; edges touching; 12 in. from work	1.2	1.1
250-watt drying lamp in 9 in. gold-plated reflectors; edges touching; 12 in. from work	1.8	1.5
250-watt drying lamps in 8 in. gold-plated reflectors; edges touching; 12 in. from work	2.0	1.7
500-watt drying lamps in 12 in. gold-plated reflectors; edges touching; 12 in. from work	2.5	2.2
1000-watt drying lamps in 12 in. gold-plated reflectors; edges touching; 12 in. from work	5.0	4.4
Sunlight; summer at noon; sea level		0.7

*See Fig. 1.

duced baking time thus obtained is not caused by catalytic action but by the attainment of a higher temperature in a short time. This has been confirmed by tests made by the Glidden Company and the Pontiac Paint and Varnish Company. Their conclusions were that an ordinary baking oven operating under temperatures available from radiant energy, would produce the same results in the same time. It follows that radiant drying is merely an effective method of getting heat into a paint film in a minimum of time.

The surface with the highest reflection factor for infra-red energy is gold plating; copper and silver plating are close to gold; Alzak is also well suited for redirecting the near infra-red energy. Other materials, such as chromium and aluminum, are less efficient; silver and copper tarnish quickly. Gold-plated reflectors are more stable than silver, but they should be cleaned every six weeks when drying lacquer. Efficient reflectors redirect the radiant energy so thoroughly that there is no sensation of heat near the reflectors, even when

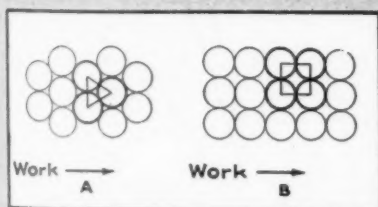
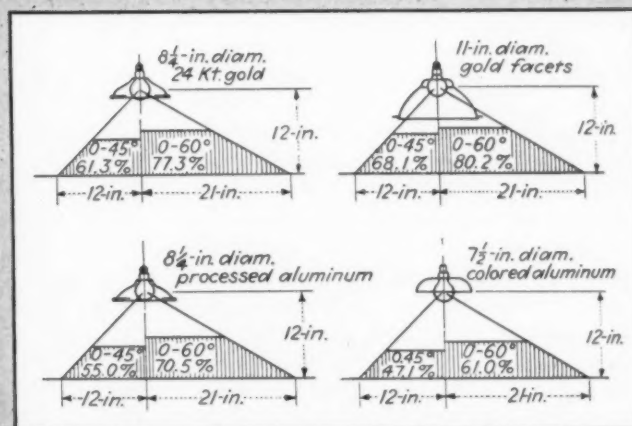
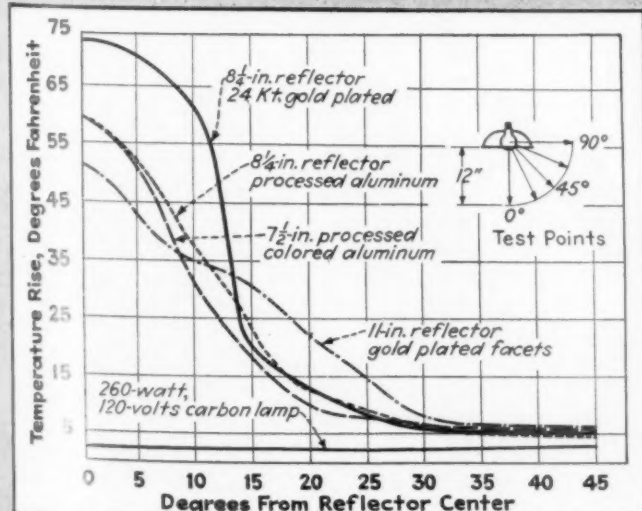


Fig. 1 — Of these two ways of arranging light units, Method A gives fifteen per cent greater concentration and better energy distribution than Method B.

Fig. 2 — Size and material of the reflector have a marked influence

on the effectiveness of the heat source, as shown by these curves.

Fig. 3 — The type of reflecting surface and the angle of cut-off determine the per cent of total radiation delivered to the working plane according to actual test.



they are operated in groups of hundreds.

TABLE II — REFLECTION FACTORS OF PIGMENTS

PIGMENT	Wave-length (Angstroms)		
	6,000	9,500	44,000
Cobaltic oxide —			
steel gray	3	4	14
Chromic oxide —			
dark green	27	45	33
Lead oxide —			
yellow	52	—	51
Ferric oxide —			
red	26	41	30
Lead chromate —			
yellow	70	—	41
Zinc oxide —			
white	82	86	8
Lead carbonate —			
white	88	93	29

Tests indicate that a concentration of six watts per sq.in. on 20-gage black painted sheet steel will give a temperature of 500° F. in five minutes while a concentration of two watts per sq.in. will give a temperature of only 220° F. in the same time. Concentration of energy depends on the wattage of the lamps, as well as the design and spacing of the reflectors.

The amount of heat at the surface of the part varies inversely as the square of the distance to the lamp. In commercial practice this distance is only 6 to 18 in., depending on the time the pieces stay under the lamp. The design of the reflector is much more important than is the distance from lamp to surface.

Tests conducted in the lighting laboratory of Commonwealth Edison on infra-red reflectors indicate that reflector diameter is a factor in determining radiation density; the solid angle subtended by a reflector is a factor with regard to glare and to percentage of lamp energy redirected to the working plane. With a reflector which has a cut-off below the filament center, glare in the eyes of adjacent operators is prevented to a considerable extent.

From Fig. 1, it might be concluded that the 8¼-in. and the 11-in. gold-plated reflectors were about on a par, but reference to Fig. 2 shows that the total radiant energy delivered on the work by the 11-in. reflector exceeds that given by the 8¼-in. unit. For any given lamp, the total radiant energy delivered on the work may be greater for a smaller-diameter reflector even

though that reflector individually has the lower efficiency. Thus, with the 11-in. reflector made up into banks, the spacing ordinarily would be 12 x 12 in., or 144 sq.in. per 260 watts, whereas the 8¼-in. reflector ordinarily would be mounted on 8½ x 8½-in. centers, corresponding to 72 sq. in. per 260 watts.

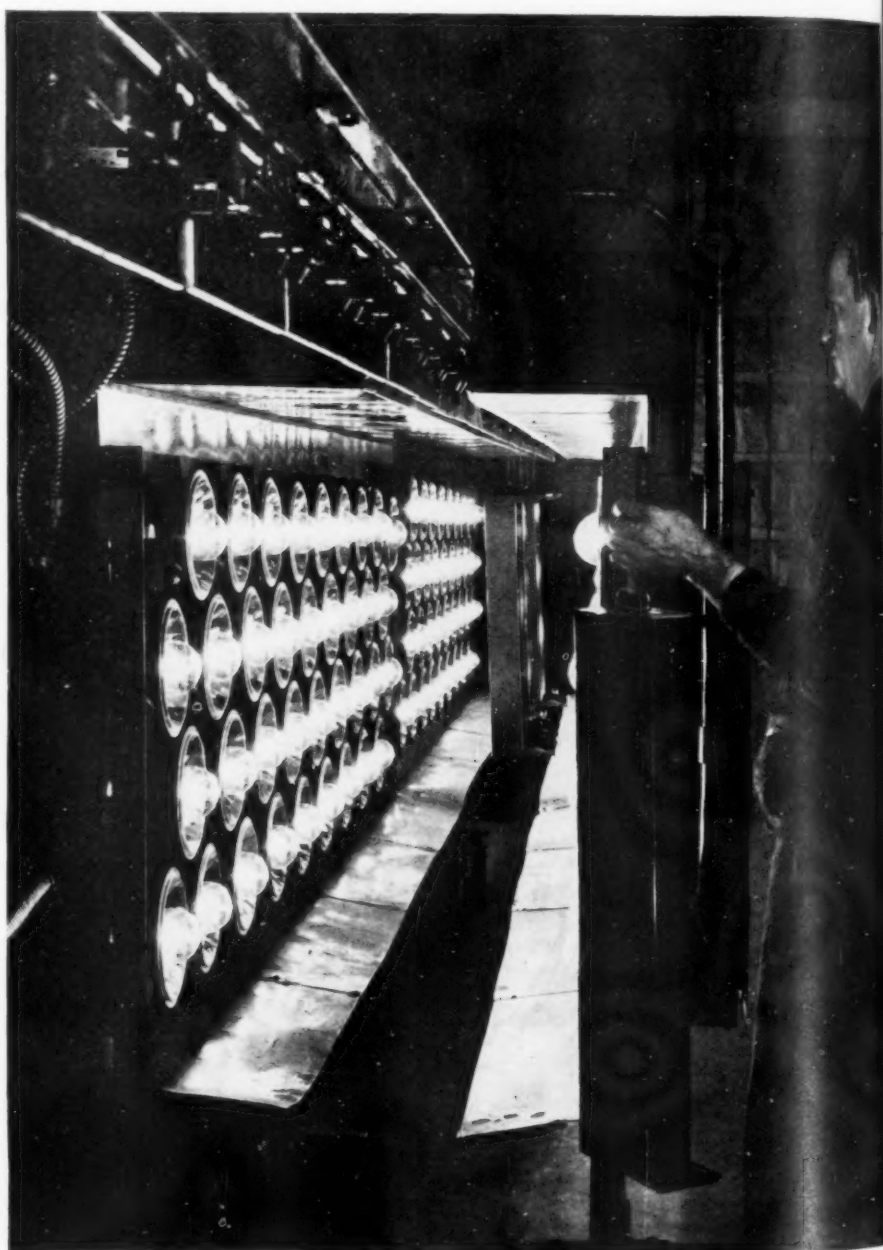
Higher reflection factors of the surface do not remain constant but change with the wave-length of the infra-red; this variation is indicated for some pigments in Table II.

Reflection factor, or ability to absorb energy, depends on the pigments and color. Hence white and other

light colored finishes cause more difficulty in getting the rapid baking desired for good production. In one application where a high reflection factor was encountered, the reverse side of the metal was heated, drying the paint by conduction, as the bare steel effectively absorbed enough of the available energy to dry the finish.

Red colors, next to white, are the most difficult to dry because of their generally high reflection factor in the infra-red range. Blues and greens are good in absorbing radiation.

Various colors on thin gage steel sheets have been tested. White paint reached a temperature of 315 F. in



The Steel Storage File Company uses a baking schedule under five minutes for enamel finish with this radiant infra-red installation.

eight minutes while red, yellow and gray reached successively higher temperatures up to black which reached 160 F. also in about eight minutes. Aluminum paint reached only 250 F. in the same time interval.

Large mass with a limited surface presented to the rays will conduct heat away from the surface and retard drying. This effect is useful when baking cores or motor armatures.

The curves in Fig. 5 in white and black indicate that thickness has an appreciable effect on the "heating-up" time. In four minutes a 14-gage panel reached a temperature of about 230 F. while a 20-gage panel, only about half as thick, reached a temperature of about 260 F. in the same time. In eight minutes the temperatures were 300 to 325 F., respectively. If baking time is long enough, the work is heated through, and from then on its thickness has no further effect. With finishes which have a short baking time, the thickness has a definite effect on the production rate since a large percentage of the total time is consumed in bringing heavier gages up to temperature.

Other factors which affect the rate of drying are: the specific heat and conductivity of the material; heat

TABLE III—HARDENING CHARACTERISTICS OF FINISHES

Material	Baking Temperature	Comment
Synthetic enamels; alkyd synthetic and urea-formaldehyde modified synthetics	250-350 F. (1.75-2.0 watts per sq.in.) 350-400 F. (about 2.8 watts per sq. in.)	Harden by polymerization and/or oxidation. Oil modified resin is used instead of an oil as the vehicle. Response to infra-red treatment depends on pigments and color.
Lacquers	100-150 F.	Harden by evaporation. Since they are dried at low temperature to avoid pinholing and budding no discoloration will occur. Formerly air dried because of the low temperatures, use of infra-red has proven a great time saver.
Wrinkle finishes	150-450 F.	More difficult to bake out because of the high temperatures required and longer time required for oxidation.
Japans		Baking japans have not proven economically feasible for this method of drying as the vegetable oils which they contain harden too slowly. Air-drying japans, however, offer no difficulty.

losses from low temperature radiation by the work; air currents or drafts; conduction to backing or supporting members; area presented as a "target" for the rays; film thickness and type of finish.

While the cooling effect of drafts should be kept to a minimum, a certain amount of air movement is required to keep the volatiles from reaching inflammable concentrations. With proper technique there is no danger of explosion.

For parts having large surfaces it is necessary to present as much as possible of the total area to the energy source by proper lamp or conveyor arrangement. Parts with recesses may cause difficulty because they heat unevenly or because the radiant energy does not reach all the areas to be dried. Unusual or difficult applications of this sort must be solved by trial installation. In an electric auto parts plant, it was found that by rotating parts of irregular area under the lamps, synthetic enamels were dried satisfactorily in 10-15 min. instead of the 60 min. required by gas oven.

Air-dry finishes may be handled by infra-red drying at temperatures not exceeding 150 F. House paints and architectural finishes made with oleo-resinous vehicles do not behave satisfactorily with infra-red. Synthetic enamels and wrinkle finishes require higher temperatures but cause no particular difficulty. Temperatures as high as 600 F. have been satisfactory

for baking wheel finishes. All synthetic enamels do not respond to infra-red drying to the same degree, as some tend to "yellow" because of the actinic property of the light.

Discoloration may occur if the temperature under the lamp is allowed to exceed the baking temperatures. Most of the organic pigments are sufficiently stable to be heated successfully, if careful control of temperature is exercised. Some finishers have found that the substitution of inorganic substances for organic pigments solves the problem of control.

Insofar as the other constituents of enamels are concerned, some of the resins in the finish may cause no particular trouble. See Table III. Speed of baking depends somewhat on the oils introduced to modify the resins; perilla and tung oil have been found to be satisfactory. Soya oil vehicles dry too slowly for the infra-red method.

Experiments in drying oil-base paints, similar to house paints were unsuccessful when application to farm equipment and to wooden toys was attempted. Oil paints and oleo-resinous materials in general cannot be baked rapidly enough under infra-red lamps because they require considerable oxidation.

Ford has used infra-red heating in expanding pistons for inserting piston pins. One outboard motor manufacturer is reported to have used the method in making shrink fits. In the

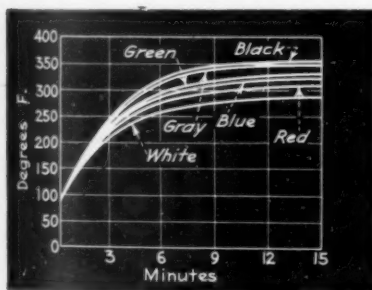


Fig. 4—The temperature reached during drying time varies with the color of the paint; these readings were on 22-gage sheet steel.

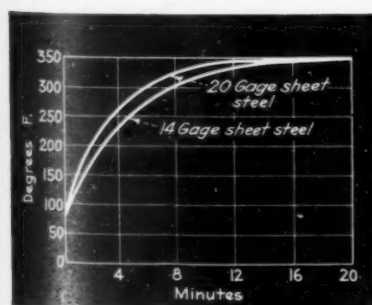
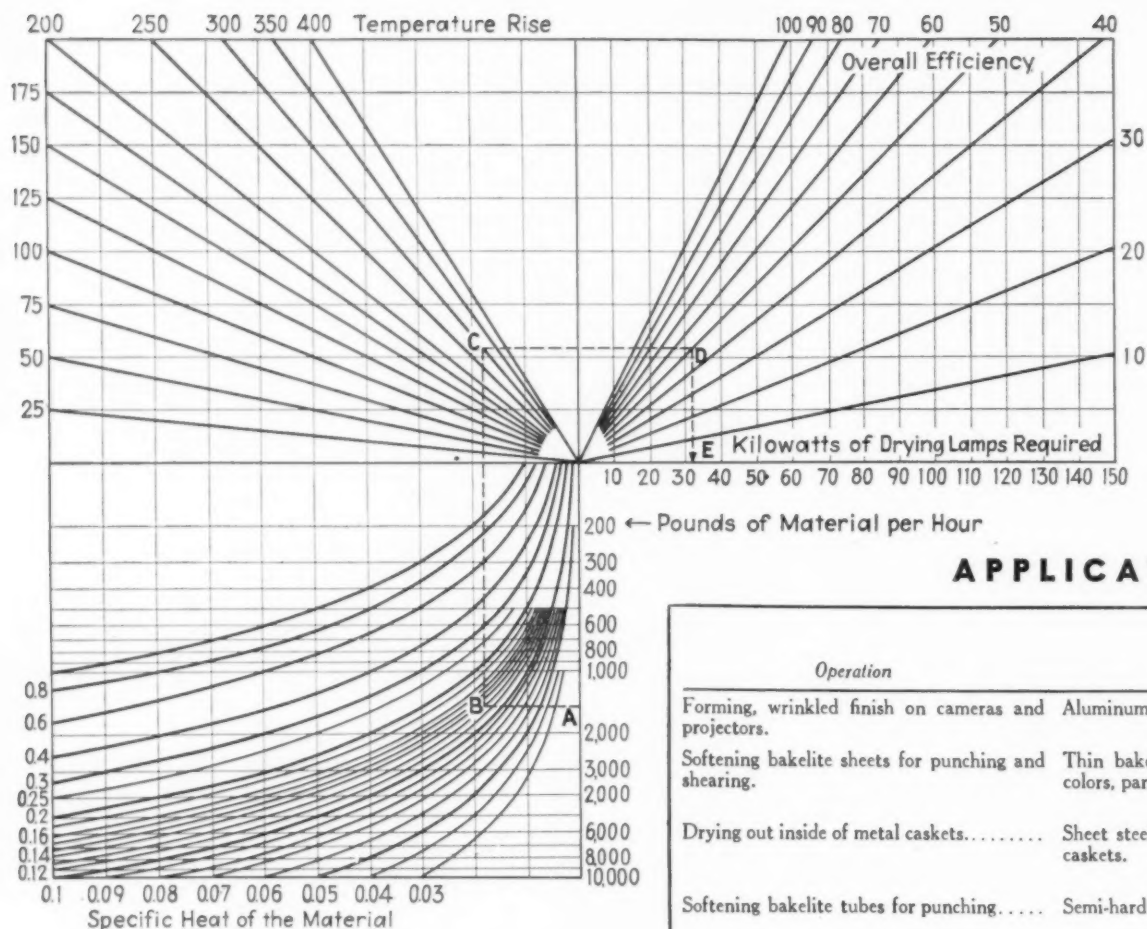


Fig. 5—The temperature is also affected by the thickness of the panel on which paint is applied; note the more rapid rise for the lighter material.



Approximate kilowatts of lamps required for mass heating. Starting with the weight of material at A proceed to specific heat B, vertically to the temperature rise C, across to overall efficiency of lamp bank D and down to the kilowatts required E.

latter application, concentrating reflectors were found better than the parabolic type. However, much time was required by this method. Handling of plastic sheets has been simplified by softening them with infra-red lamps instead of in ovens prior to punching or forming. Fiber board is also successfully heated and softened prior to bending to shape. These are but a few applications of the principles of radiant heating discussed.

Infra-red heating has the advantage over air or oven drying in that heat is instantly available with the lamps whereas some time is required to bring the parts and oven up to working temperature. The prime coat on Ford bodies is baked in fifteen minutes with infra-red lamps as compared to sixty minutes required by a steam oven that was replaced. Finishing coats require about twice as much time as prime coats with even greater saving over previous oven drying schedules. Comparisons of baking times between lamp ovens and conventional ovens may be misleading since often there are special condi-

APPLICATIONS OF

Operation	Material
Forming, wrinkled finish on cameras and projectors.	Aluminum die-cast metal.....
Softening bakelite sheets for punching and shearing.	Thin bakelite sheets, black and tan colors, parts punched out.
Drying out inside of metal caskets.....	Sheet steel pressed and welded burial caskets.
Softening bakelite tubes for punching.	Semi-hard bakelite.....
Baking out radio coils and transformers....	Electrical coils and windings on fiber or bakelite cores.
Enamel baking on small metal stampings. . .	Sheet metal display with pressed pocket for advertising.
Removing cyanide from pits and pores in castings.	Gray cast iron.....
Baking finish on transformer cases.....	Pressed sheet steel boxes (22 gage)....
Drying adhesive lacquer or glue on speaker cones.	Steel frame and paper cones.....
Laboratory use — baking finishes on cans. .	Tin cans, labels and decoration printed directly on tin.
Expanding pistons to permit dropping pins in place.	Aluminum alloy pistons.....
Softening bakelite for punching and shearing.	Bakelite strips from which small parts are punched by press.
Drying paste to hold jewels in place.	Plated brass and die cast metal.....
Baking enamel finish on globe valves.	Cast or wrought iron and brass.....
Baking wrinkled finish on die-cast auto heater cases or frames.	Die-cast frame or case for auto hot water heater.
Baking enamel on molded bakelite radio cabinets.	Small portable radio cabinet of molded bakelite — mottled brown color.
Baking out synthetic urea formaldehyde enamel on metal.	Test samples of steel sheet.....
Drying ground coat preparatory to firing on at high temperature.	Steel sheet.....
Drying first finish coat on fired ground coat..	Steel pan with vitreous ground coat fired on.
Baking synthetic enamels on small axe blades.	Steel axe blades.....
Dehydrating or drying Tenite preparatory to molding.	Tenite (a plastic) granules, various grades and colors.

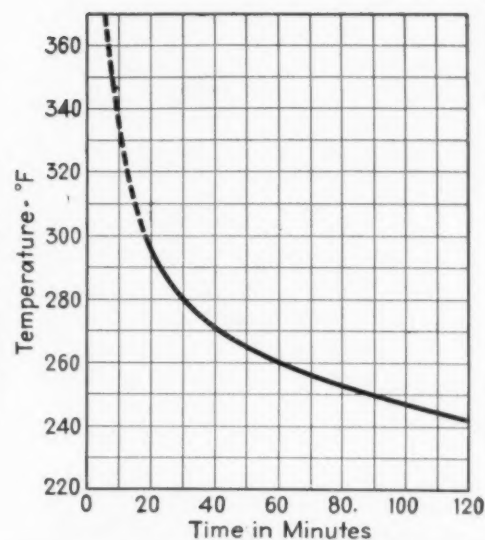
* From investigations of radiant energy heat made by the Commonwealth Edison Company.

tions which favor one method against the other.

It has been pointed out by the American Gas Association that any baking results obtained with electric infra-red lamp equipment can also be obtained with gas equipment at a comparable cost and, it is claimed, with certain definite advantages. Radiant gas burners have satisfactorily dried white urea formaldehyde finishes, usually difficult to dry successfully with electric equipment.

Usually lacquers and quick-drying

The time of baking paint is shortened by increasing the temperature; but since most organic pigments tend to fade at elevated temperatures, caution must be exercised. (Graphs are from a paper by Howard Haynes, Nela Park Engineering Department, General Electric Company, before the Illuminating Engineering Society)



RADIANT ENERGY HEATING*

Size in In.	Finish	No. and Size of Lamps	Total Watts	Reflector Diameter and Spacing In.	Reflector Finish	Distance in In. of Filament From Work	Time Under Lamps	Watts/Sq. In. on Work
2 x 4 x 6	Synthetic plastic wrinkle finish sprayed on.	4 — 250W Tungsten	1000	8 1/4 dia. 9 1/2 spacing	Alzak	8	6 min.	2.75
3 x 4 ft. 1/8 thick	None — softening.	16 — 240W Carbon	3840	8 1/4 dia. 8 1/2 spacing	Alzak	12 to 24	3 1/2 sec. Cont. after 2 min. preht.	0.9
16 x 24 x 72 Approx.	Plated or oxidized surfaces from which moisture must be removed on inside.	10 — 260W Carbon	2600	None — special arrangement	None	3 to 8	5 to 10 min.	0.40
3 dia. by 16 x 1/16	None — softening.	8 — 240W Carbon	1920	8 1/4 dia. 8 1/2 spacing	Alzak	12 to 18	Continuous after 2 min. preheat.	1.2
3 dia. x 2 long	Insulating varnish impregnation	16 — 260W Carbon	4160	8 1/4 dia. 8 1/2 spacing	Alzak	10 avg.	4 min.	1.6
4 x 6 x 1/32	Red enamel sprayed on.	16 — 260W Carbon	4160	8 1/4 dia. 8 1/2 spacing	Alzak	12	12-15 min.	1.33
10-14 dia. 1 1/2 x 2 height	Plating after wash in cyanide and hot water.	24 — 260W Carbon	6240	8 1/4 dia. 8 1/2 spacing	Alzak	7 varied	20 min.	3.2
3 x 3 x 4	Black nitro-cellulose lacquer with solvent — 5 min. air dry, 10 min. under lamps, 10 min. air.	30 — 260W Carbon	7800	10 dia. 12 spacing	Gold	8	10 min.	3.50
6 dia. cones 3 height speaker	Nitro-cellulose adhesive lacquer.	88 — 260W Carbon	22880	7 1/2 & 9 1/4 dia. 7 1/2 & 9 1/4 spacing	Gold & Color Alumilited	8	Continuous — 2 ft. per min.	2.40
2-3 dia. 4-5 height	Enamels, lacquers, inks.	3 — 260W Carbon	780	9 1/4 dia. 9 1/4 spacing	Gold	Not known	Laboratory use	Varied
4-5 dia. 6 height	None — Expanding metal operation.	4 — 260W Carbon	1040	7 1/2 dia. 7 1/2 spacing	Color Alumilited	6	3 min.	2.25
2-3 x 48	None — softening.	16 — 260W Carbon	4160	7 1/2 dia. 7 1/2 spacing	Color Alumilited	14	Continuous after 2 min. preheat.	
1/2-1 dia. 1/16 thick	Jewelers' paste.	2 — 260W Carbon	520	None—in inclosure	None	Not known	5 min.	Inclosed
Up to 1 1/2 valves	Green air dry enamel.	8 — 260W Carbon	2080	8 1/4 dia. 8 1/2 spacing	Alzak	6-8	5 min.	2.75
10-12 dia. 4 1/2 height	Wrinkled finish enamel — grayish tan color — wrinkle formed in 3 min.	32 — 260W Carbon	8320	8 1/4 diameter 8 1/2 spacing	Alzak	10-12	9 min.	3.7
6 x 8 x 14 1/8-1/2 thick	Urea formaldehyde baking (220 F.) cream color.	32 — 260W Carbon	8320	8 1/4 diameter 8 1/2 spacing	Alzak	8-12	9 min.	3.7
3 x 6 (18 gage)	Synthetic enamel, urea formaldehyde, air-dry enamel — Chinawood, soya and melec oils.	8 — 260W Carbon	2080	8 1/4 diameter 8 1/2 spacing	Alzak	12	7 min.	1.8
12 x 12 20 gage	Water solvent ground coat gray color.	24 — 260W Carbon	6240	8 1/4 diameter 8 1/2 spacing	Alzak	10	9 min.	2.6
7 x 15 x 4 1/2 deep — 20 gage	Water solvent white first finish coat.	24 — 260W Carbon	6240	8 1/4 diameter 8 1/2 spacing	Alzak	10	5 min.	2.6
3 x 5 3/4 Blade edge to 3/4	Gloss black synthetic enamel and thinner.	8 — 260W Carbon	2080	8 1/4 diameter 8 1/2 spacing	Alzak	12	15 min.	2.2
1 layer in pan 22 1/2 x 30 x 3 1/2	No finish — moisture removal..	8 — 260W Carbon	2080	8 1/4 diameter 8 1/2 spacing	Alzak	30	20 min.	0.8

enamels can be dried rapidly. Occasionally, however, it is just as difficult to eliminate the slight tack of synthetic lacquers as it is to bake a true baking enamel because of the time required for oxidation. The fast-drying enamels best suited for lamp drying are made with short oil modified alkyd (glycerol phthlate) resins which may be further modified with urea-formaldehyde resins if greater hardness is desired. If high enough intensities are available, non-drying alkyd and urea-formaldehyde combinations are useful.

Space saving with infra-red heating may amount to as much as 50 per cent. A 15-kw. infra-red installation of 250 watt lamps required a floor space of about 30 sq. ft. as compared to 64 sq. ft. for a 15-kw. strip heater oven. Flexibility is secured by cutting banks of light in and out as required; and lights are adjustable to any direction. Distance of the lamps from the parts is usually adjustable for the full effective range of the lamps. Small banks of reflectors are mounted on rollers and used for spot drying of finishes in both automotive and aircraft manufacture and maintenance. Initial cost of infra-red installations is comparatively low. Maintenance is confined to replacement of lamps and cleaning reflectors. Further, the installations can be dismantled and rebuilt to suit new requirements.

An Early Handspray

By E. M. Stephenson

The first small handsprayer that I saw many years ago was used to spray buttons, and as may be noticed from the illustration, it had no control. The air was supplied from a line used for a sand blasting machine and sometimes



Picture of one of the first hand sprays.

air pressure would be 100 pounds per square inch and again it might be only 10 pounds. If you were not careful when the pressure increased, much of the work might be blown out the window.

On moving the coffee cup from side to side, much of the finishing material was spilled upon the floor, to say nothing of what went out the window. No blowers or sprayhoods were available and the spraying room floor looked like a miniature Grand Canyon with hills and dales of different colors. You had to keep one eye on the floor so you would not slip, leaving only one eye for the work. Both hands were kept busy; one holding the cup and the other holding the spray. There was no time for argument as you had to be on the job every minute, but today spraying is an easy task, and in fact, a pleasure, thanks to the spray equipment manufacturers.

Dipping Long Castings

A long time ago I came across a manufacturer who was dipping long castings in only 6" of japan. They used the old method of water-dip lacquering and instead of using 50 gallons of japan to fill the tank, they used only 10 gallons of japan and 40 gal-

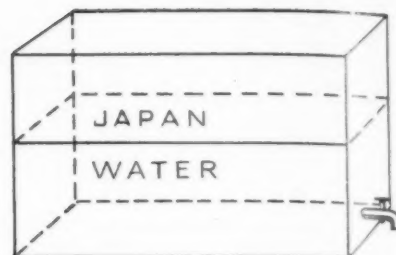


Diagram illustrating method of dipping long castings using little japan.

lons of water. By the time the work was dipped through the japan, it was coated and the water did not displace or harm the coating in any way. As shown by the illustration, the japan floated on the surface of the water.

This technique, of course, can only be used when all of the components of the japan are insoluble in water.

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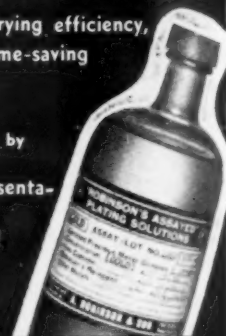
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Aircraft Engine Finishes*

DR. MYRON A. COLER

*Engineering Products Division
Paragon Paint & Varnish Corp.,
Long Island City, New York*

As a result of recent developments affecting the aircraft industry, the problem of designing suitable specifications for aircraft engine finishes is becoming one of increasing importance. Present practice and trends in the finishing of crankcases and cylinders are briefly reviewed, in order to indicate the factors which must be taken into account in a practical analysis of the specification problem.

While some confusion exists regarding the details, there can be little doubt that in the immediate future various Government departments will proceed to acquire thousands of planes—primarily for military purposes. Since many types of planes require several motors, a correspondingly larger number of engines will be needed. In order to protect them from corrosion and maintain proper appearances, these engines will not only have to be finished initially, but will have to be refinished at frequent intervals thereafter throughout their useful lives; these intervals will normally coincide with the periods between major overhauls. The finishes for Government planes will naturally have to meet Government specifications. Moreover, many of the engines which are not built for Government use will, as they are now, be finished in accordance with these same Government specifications, either because of confidence in the existing specifications and lack of better ones, or because the observation of a minimum number of distinct specification set-ups permits more uniform shop procedures. It is possible that other internal combustion engines such as those used in motorcycles, tanks and marine motors may be similarly finished since, as will be pointed out later, the essential requirements of the various types of engines have much in common, and since these specifications are so worded that they are not limited to aircraft applications.



Dr. Myron A. Coler

The finishing of aircraft engines is a peculiar problem from the standpoint of those who are accustomed to focusing their attention on the chemical aspects of things. The personnel of the aircraft industry who, among numerous other duties, see to it that engines get finished, are preoccupied with the more pressing aerodynamical, mechanical and metallurgical problems. As a survey of the literature and practical field activities will reveal, scientists have, until quite recently, neglected the complex and delicately interrelated phenomena involved in the chemistry and physics of engine finishing. Thus, the chemist who enters the field finds himself confronted with regulations and conventions which must be respected because they represent "the way things are being done" and often because they are based on subtle and valuable observations made by aircraft workers who have different ways of looking at things. Therefore, in order that we may have a better background for considering the specification problem, we shall review brief-

ly some of the technical phases of aircraft engine finishing with emphasis on current practice and the aircraft engineer's viewpoint.

General Notes on Finishing of Engines

The refinishing of engines is essentially a maintenance job. In order to avoid accidents due to failure in flight and to obtain efficient running characteristics, aircraft engines must be periodically inspected and overhauled. The period for a major overhaul is commonly of the order of two hundred to seven hundred and fifty hours of operation, depending on the nature of the plane and the servicing policy of the owner. A thorough inspection involves such procedures as "magnafluxing" of the valves and other steel parts, testing of springs and examination of the cylinders and crankcase for incipient cracks and other flaws, so that it is necessary to disassemble the engine completely. In order to examine the exterior surfaces of the cylinders and housings, it is usually necessary to strip them down to the base metal. When the essential mechanical requirements have been satisfied, the cylinders and crankcase are refinished and the engine is put together again. In field service work, the engine is then placed on a test rack and run for eight or ten hours, and if it performs satisfactorily, it is reinstalled in the plane. The large amounts of time, material and skilled labor involved explain the fact that men responsible for the manufacture and servicing of aircraft engines are sincerely interested in improved engine finishes but are not eager to try dubious "experiments".

Since an engine must be overhauled many times in the course of its useful

*Presented before the Division of Paint and Varnish Chemistry at the 100th Meeting of the American Chemical Society, Detroit.

TABLE I
METALS USED FOR CRANKCASES AND CYLINDER EXTERIORS OF REPRESENTATIVE MODERN AMERICAN AIRCRAFT ENGINES

Engine	Cylinder Type	Cooling Type	Crankcase	Cylinder Barrel	Cylinder Head
Aircooled Franklin 4AC-171	4	Air	Cast aluminum alloy	Cast aluminum alloy, British Y	Cast aluminum alloy, British Y
Akron Funk B	4	Liquid	Aluminum	Cast iron	Cast aluminum
Allied Monsoon	4-in-line	Air	Heat-treated aluminum lower half; magnesium rear half and top covering	Forged steel	Heat-treated aluminum alloy
American S-5-125	5-radial	Air	Cast aluminum alloy	Nickel iron	Aluminum alloy
Continental A-75	4-opposed	Air	Cast aluminum alloy	Forged steel	Cast aluminum alloy
Jacobs L-6MB	7-radial	Air	Magnesium and aluminum heat-treated alloy castings	Forged chrome nickel molybdenum steel	Cast aluminum alloy
Ken-Royce Model 7F	7-radial	Air	Cast aluminum alloy	Forged steel	Cast aluminum alloy
Kinner SC-7A	7-radial	Air	Cast aluminum alloy	Forged steel	Cast aluminum alloy
Lenape Brave	5-radial	Air	Magnesium casting	Forged, hardened alloy steel	Cast aluminum alloy
Lycoming R-680-E Series	9-radial	Air	Cast heat-treated aluminum alloy	Carbon steel	Aluminum alloy
Menasco Buccaneer	6-inverted in-line	Air	Cast aluminum alloy. Magnesium cover plate	Cast nickel iron - or - SAE 3140 Steel	Cast aluminum alloy
Monocoup Lambert R-266	5-radial	Air	Magnesium alloy	Nickel semi-steel casting	Heat-treated aluminum alloy
Pratt & Whitney Twin Wasp	14-radial	Air	Forged dural, aluminum alloy nose section. Cast magnesium blower and accessory section.	Forged chrome molybdenum steel	Cast aluminum alloy
Ranger SGV-770B	12-60° Vee	Air	Cast aluminum	Forged steel	Cast aluminum
Skymotors 70A	4-inverted in-line	Air	Aluminum alloy	Cast aluminum alloy	Cast aluminum alloy
Warner Super Scarab 165	7-radial	Air	Heat-treated aluminum alloy	Alloy steel	Heat-treated aluminum alloy
Wright Double-Row Cyclone 14	14-radial	Air	Forged aluminum alloy	Nitralloy steel, nitrided	Cast aluminum alloy

life, the quantity of finishing work done by the servicing agencies must greatly exceed that done by the original manufacturers. In the following more detailed discussion of engine finishing, we shall, therefore, have field servicing conditions chiefly in mind. However, it should be noted that there is no conflict between the requirements of these groups although there may be a difference in emphasis. The manufacturer and the service man are both interested in fine-looking finishes which may be easily and quickly applied, which will resist heat, oil, gasoline, salt-spray and similar corrosive influences, and which may yet be stripped readily under conditions that will not vitally impair the base metal. Ob-

viously, there are local variations in finishing procedures and techniques; the statements of this paper are based primarily on extensive field observations and seek to describe representative average practice.

Metals used for crankcase and cylinder exteriors of representative modern American aircraft engines are recorded in Table I. These data were selected from a list of basic types appearing in the Aero Digest "6th Annual Digest of Aircraft, Engines, Accessories"¹. "These engines are manufactured under Civil Aeronautics Authority Approved Type Certificates, are currently in production and available for private, military or commercial aircraft." The consideration of just crankcase

and cylinder parts naturally entails a certain over-simplification of the engine finishing problem since a number of parts such as the exhaust manifolds, spark plugs and baffles may require special treatments. However, in the interest of brevity and coherence we shall introduce this restriction.

Finishing of Crankcases

As indicated in Table I, crankcases are, in the interest of weight-economy, made of light materials such as the alloys of magnesium and aluminum. The coating of these metals, particularly the high magnesium alloys, requires special precautions to insure adequate adhesion⁵ especially when the engine must function in a marine atmosphere.

The problem of surface treatment has been the subject of a great deal of study in recent years; two of the most widely used treatments are the anodic oxidation process for aluminum and aluminum rich alloys and the chrome-pickle treatment for magnesium alloys.^{5,10,11,16} The average service unit is not in a position to carry out these treatments on large sections, so that they are applied chiefly at the point of fabrication. Cast aluminum alloy parts, such as crankcases, are usually rough enough to insure adequate adherence without special treatment and are thick enough so that a little corrosion will not necessarily weaken the structure (which can be promptly protected to prevent further corrosion).¹⁶

The case for magnesium alloys has been well summed up by the Dow Chemical Co.¹¹: "As it is difficult to control the location and service conditions to which an article is exposed in service, a general recommendation is made that Dowmetal parts be painted wherever possible. Chemical surface treatments have been developed that act as excellent bases for subsequent paint coats, and primers and finishes are now available that give excellent adhesion and protection."

The first purpose of aircraft painting is, of course, *protection*, so that the priming coat must not only adhere well to the specific base metal, but should also be capable of inhibiting corrosion which may start at points of accidental film rupture. Zinc chromate primers prepared in accordance with the very strict Navy Aeronautical Specification P-27b are the most widely used materials for this purpose. Frequently the use of such primers is specified so that even crankcase finishing enamels which are self-priming should be capable of forming good adherent topcoats over these primers.

The above comments are general and are applicable to all sorts of aircraft finishing work involving the metals and alloys mentioned; we shall now consider some of the specific requirements which arise in connection with the finishing of crankcases in service work. Because of the bulkiness and often complicated configurations of the sections, baking is inconvenient and, therefore, air-drying finishes are preferred. Because of the intricate shapes and large numbers of fitting holes which must not be fouled with paint, dipping is practically impossible and spraying requires elaborate

masking precautions so that brushing finishes are also preferred. Since the chief function of a topcoat is to maintain the good appearance of the engine, suitable finishes should be able to resist for appreciable periods such destructive influences as hot lubricating oil and high-velocity moist salt spray from propeller action when the plane is in a marine atmosphere. The temperature rise, due to the heat of the engine itself, not only tends to speed up these corrosion reactions, but also works for the thermal decomposition of the film, so that unless pigments and resins of good thermal stability are employed, appreciable yellowing, loss of gloss and similar undesirable changes in appearance may occur. This is particularly noticeable when a color such as the conventional "engine blue-gray" is used. Crankcases do not heat up uniformly and the maximum temperature reached will naturally depend on the type of engine and conditions of operation. Satisfactory crankcase enamels may be formulated on a wide variety of varnish bases including drying oil-natural resin cooks, oil and phenolic modified alkyds and cellulosic types. Navy Aeronautical Specification E-5e, which may be applied to crankcase work, calls for a high glyceryl phthalate content alkyd free of rosin and rosin derivatives.¹²

Many of the finishes in commercial use require air-drying periods of the order of eight hours or more before they dry sufficiently hard to permit handling. In shops where it is convenient to enamel the crankcase one day and assemble the engine a day or two later, this slow drying is not objectionable. However, to meet the real need and growing demand for high-speed finishes, recently developed crankcase enamels have been made to dry completely tack free within an hour or less.

Finishing of Cylinders

As indicated in Table I, modern aircraft cylinders have steel or iron alloy barrels and cast aluminum or aluminum alloy heads. Ferrous metal heads may also be used.⁷ The large majority of engines are air-cooled, so that cylinder exterior temperatures of the order of 500 or 600°F must be allowed for in designing suitable finishes. Cylinders are sometimes finished by metal spraying³ but most

cylinders are finished with organic coating materials.

"Metallizing," a form of metal spraying is done with aluminum or one per cent zinc aluminum³. Compared with painting processes, metal spraying is expensive and requires relatively elaborate equipment. The natural heating up of the cylinders may result in the formation of a desirable alloy base and the conversion of some of the aluminum to a tough oxide layer⁶. However, a great deal of care is necessary to obtain adequate coating without piling up metal on the fin peripheries. This is a potentially favorable set-up for accelerated electrolytic corrosion since a hot iron-aluminum couple may thus be exposed to the action of air and a moist salt spray. It is worth noting that the coefficient of linear expansion of aluminum and many of its alloys is approximately twice that of steel and iron and that the cylinder surface is constantly expanding and contracting with changing cylinder temperatures. It is common knowledge that a piece of strained metal will, in general, assume a potential relative to an otherwise similar unstrained piece cut from the same strip; cylinder heads are frequently shrunk onto the barrels so that the differential stresses and corresponding strain potentials may be appreciable.

The requirements and problems involved in the design of organic finishes for aircraft cylinders have been recently discussed in some detail by the author⁸. Since the exterior surface of the cylinders is subject to essentially the same corrosive influences as that of the crankcase (only in an exaggerated form due to the higher prevalent temperatures and often closer proximity to the main propeller blast), many of the statements made concerning the finishing of crankcases are again directly applicable.

When a cylinder requires recoating, the old coat is usually removed by stripping with a liquid stripper, followed by sandblasting, or by sandblasting alone. Just as in the case of crankcase parts, the use of a specification primer such as the Navy P-27b type may be mandatory even though its heat-resistance is inferior to that of the cylinder enamel proper. Aircraft cylinder enamels are generally high gloss blacks. Both baking and air-drying finishes are widely used.

(Continued in March issue)

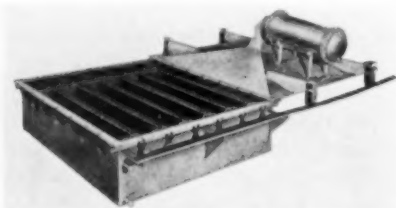
NEW EQUIPMENT AND SUPPLIES

LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

Horizontal Still (or Dryer) and Condenser

Unique among the variety of special processing equipment designed and built by L. O. Koven & Brother, Inc., Jersey City, N. J. is the still (or dryer) and condenser unit illustrated here.

The purpose of the operation for which this equipment was built is to remove from the surface of a great number of lacquered objects the highly volatile solvents which must be condensed and recovered as the objects were being dried. The particular design was adopted to assure processing in a closed system so as to avoid loss of volatile material and possible dangers. The still or dryer is therefore in the form of a flat rectangular welded steel tank which accommodates 6 smaller welded steel tanks or trays into which the objects are placed. These trays are each about 6" square x 48" long and are easily lowered into and lifted from the main tank. Surrounding and heating each tray is a bath of oil heated in turn under thermostatic control by steam coils running the full length on both sides of each tray.



Horizontal Still and Condenser

When the dryer is loaded, the domed cover is slid on tracks over the top of the tank and sealed by tightening the quick closing swing bolts.

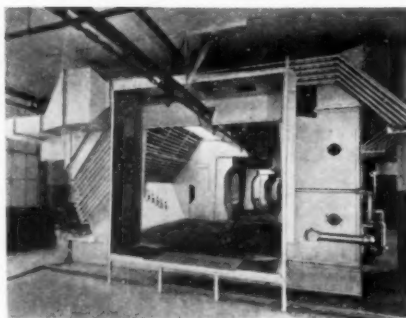
Locating the condenser on top of the cover keeps it close to the source of vapor generation and makes for a compact unit.

This design suggests a drying and solvent recovery process application on not only objects which are surface coated but also of a great many chemicals and other materials with a high percentage of solvents, assuring fully recovery of the solvents and uniform drying of the remaining product.

New Spray Booth

A new principle in a spray booth construction is claimed to be incorporated in the new "Hydro-Whirl" developed by Industrial Sheet Metal Works, Detroit.

By virtue of a changed direction of air forces, the paint is trapped before it has had the opportunity to travel very far into the booth. Consequently, all the pigment



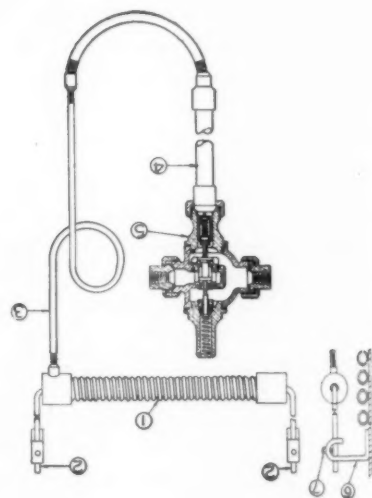
"Hydro-Whirl" Spray Booth

is brought down almost immediately after its impact with the water, into the sludge tank below, where it can easily be skimmed off. All this is achieved through the proper balance between the speeds of air and water and the static pressures. The manufacturers state that the necessity for cleaning the spray booth is thereby almost obviated and maintenance costs become negligible.

The unit may be used singly or as a part of a continuous string of booths. In the latter fashion, the arrangement is staggered and so constructed as to allow no possibility of "overspray". Washed, filtered, and temperature-controlled air is supplied to each unit in a perfect balance between supply and exhaust. This system lends itself to operation at fullest efficiency whether production is down to a minimum or up to its maximum.

Solvent Temperature Regulator

Sarco Co., Inc., 183 Madison Ave., New York, manufacturers of steam specialties, have added to their line of self-operated temperature regulators, the new instrument illustrated. This regulator, known as the "Sarco Vapor Line Control", is designed specifically to control the heating medium on solvent degreasers. It is the function of the control to automatically maintain the



Solvent Temperature Regulator



All types
of
Clear
Lacquer
for Metals

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Agate Lacquer Mfg. Co., Inc.
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correct vapor line regardless of variations in load and intermittent operation.

This control is said to save solvent, prevent boiling over of vapor and to reduce corrosion in the degreaser from overheating. The regulator is self-contained and self-operated by the liquid expansion system in which the company specializes. A novel feature is the sensitive bulb or thermostat formed of heavy-wall helically corrugated tubing, braced on the inside. This construction is claimed to expose a very large surface to the influence of the vapor in relation to its content, which results in very rapid response to temperature changes.

Temperature adjustment is made by sliding the bulb until a position is found for the vapor line in the tank, which maintains the correct boiling temperature. The regulator is available in sizes from $\frac{1}{2}$ " to 2" for temperature up to 400° F.

New Book

Lacquer and Synthetic Enamel Finishes. By Ray C. Martin. Published by D. Van Nostrand Co., New York. Size $9\frac{1}{4}$ " x $6\frac{1}{4}$ "; 303 pages; price \$5.50.

This is a handbook on lacquers and synthetic enamels covering in an up-to-date and practical way raw materials, manufacturing processes, equipment, methods of application, testing and analysis. The book is divided into five parts. The first part is devoted to nitrocellulose and cellulose acetate base materials, which are discussed in detail and following this, solvents, non-solvents, plasticisers, resins, pigments and other materials used with them, are discussed.

The second part deals with manufacturing plants and equipment. In this section coating materials are divided into various types, and typical formulations are given. Part 3 deals with testing and evaluating lacquers and lacquer materials. Part 4 concerns itself with the application of finishing materials to various objects, such as furniture and automobiles. Equipment used in applying finishes is described. Part 5 is a glossary of paint, varnish, lacquer and allied terms.

Business Items

Wm. H. Dernell has been named district manager of Southern California for Ault & Wiborg Corporation. His offices will be in Los Angeles. Mr. Dernell has been associated with the company for the past twenty years and before that was associated with various airplane companies as aeronautical engineer. He practiced civil engineering for several years and was on the staff of Thomas A. Edison as production manager of cabinet manufacturing.

G. H. Kenyon Promoted

Muir Rogers, manager of the Industrial Finishing Division of the American-Marietta Co., 43 E. Ohio St., Chicago, Ill., announced the appointment of George H. Kenyon as manager of the company's metal finishes department.

Mr. Kenyon joined the American-Marietta

Co. a year ago. He majored in engineering at Michigan State for two years and then two years at McGill University where he graduated. After leaving school, he was employed as a sales engineer by the Link Belt Co. for a number of years before finding his way into the industrial finishes field in 1933. In that year he became associated with Devoe & Reynolds Co., and later was transferred to the Jones Dabney Division of that company.

Despatch Oven Co., 622 Ninth St., S.E., Minneapolis, Minn., has announced the appointment of Gerald B. Duff as exclusive sales engineer for the company's furnaces and core ovens in the Newark-New York territory. His address is 68 Clinton Ave., Newark, N. J. Mr. Duff has had considerable experience in the furnace field, particularly in the proper handling and heat treatment of ferrous and non-ferrous metals and alloys.



No LONGER do you need a variety of special lacquers to finish several metals. M&W Universal Lacquer simplifies your production. This new, high-grade, clear M&W lacquer can be applied with excellent results on all commonly used metals and alloys.

It's the ideal lacquer for name plate manufacturers and others making products out of several kinds of metals.

Universal Lacquer is very light in color ... adheres well ... is flexible ... withstands stamping and forming ... resists outdoor weather; also sulphur ... good color retention ... air dries quickly.

Full information on request

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LACQUERS PIONEERS IN PROTECTION ENAMELS



Enthone baked enamel strippers cut actual stripping time from HOURS to MINUTES ... quickly and safely removing baked enamels of the urea-formaldehyde, resyl, glyptal, glycerolphthalic anhydride and bakelite types ... as well as many other long-oil types of japans and air-dry enamels. Non-caustic, will not etch or attack any metal. Strip rapidly—rinse freely!

Write TODAY for FREE SAMPLE and valuable advice for cutting your enamel stripping costs.

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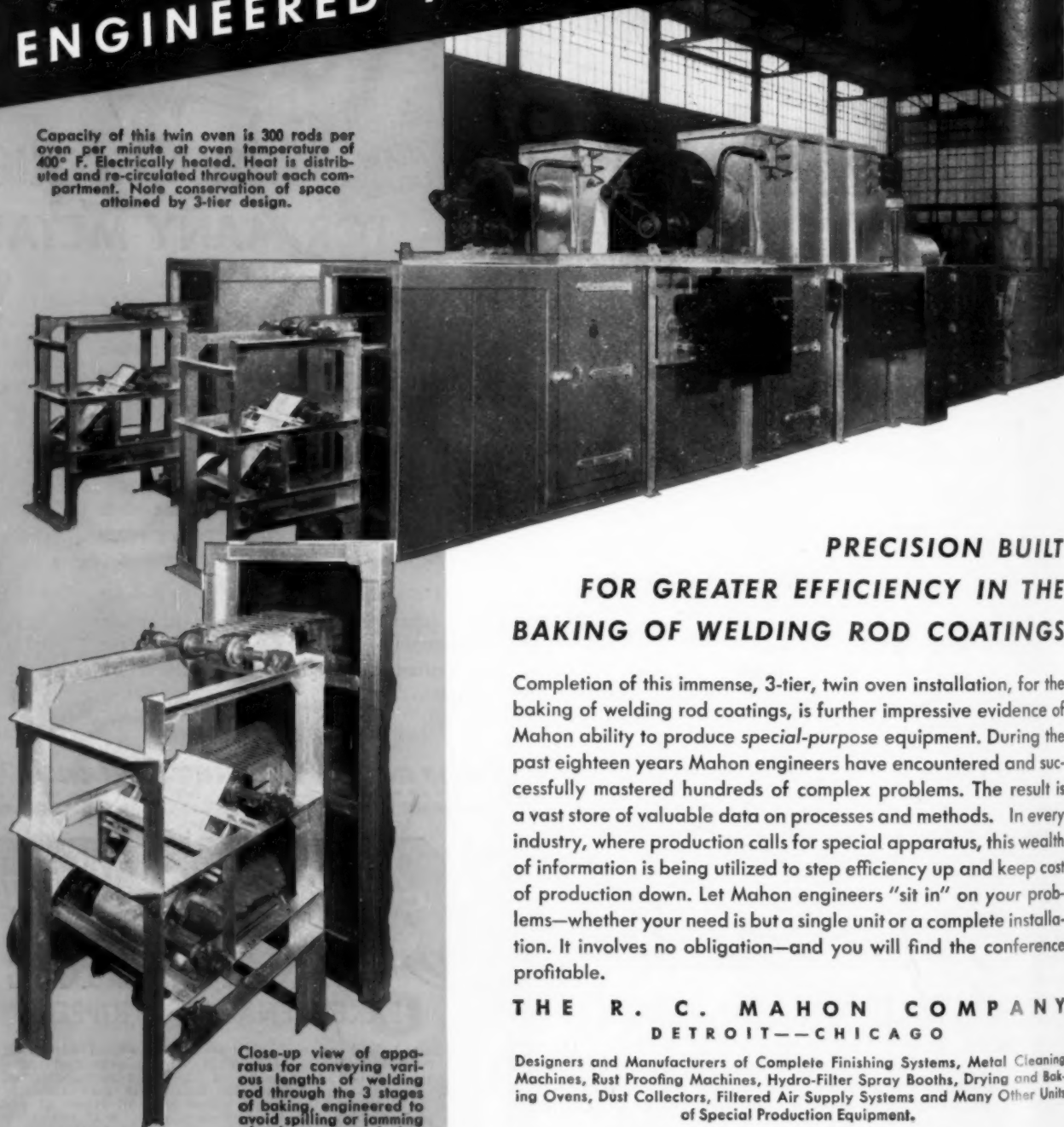
NEW HAVEN, CONN.

Chemical Products



Another Achievement in MAHON OVEN EQUIPMENT ENGINEERED FOR A SPECIFIC JOB

Capacity of this twin oven is 300 rods per oven per minute at oven temperature of 400° F. Electrically heated. Heat is distributed and re-circulated throughout each compartment. Note conservation of space attained by 3-tier design.



Close-up view of apparatus for conveying various lengths of welding rod through the 3 stages of baking, engineered to avoid spilling or jamming of rods enroute and when passing from one compartment to the next below.

PRECISION BUILT FOR GREATER EFFICIENCY IN THE BAKING OF WELDING ROD COATINGS

Completion of this immense, 3-tier, twin oven installation, for the baking of welding rod coatings, is further impressive evidence of Mahon ability to produce *special-purpose* equipment. During the past eighteen years Mahon engineers have encountered and successfully mastered hundreds of complex problems. The result is a vast store of valuable data on processes and methods. In every industry, where production calls for special apparatus, this wealth of information is being utilized to step efficiency up and keep cost of production down. Let Mahon engineers "sit in" on your problems—whether your need is but a single unit or a complete installation. It involves no obligation—and you will find the conference profitable.

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